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Better Crops with PLANT FOOD

The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*

Editorial Offices: Investment Bldg., Washington, D. C.

VOLUME XX NUMBER TWELVE

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American Potash Institute, Inc.
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J. W. TURRENTINE, *President and Treasurer*
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AN AUTUMN BYWAY HIGH UP IN THE HILLS ABOVE AMHERST.

Better Crops with PLANT FOOD

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VOL. XX WASHINGTON, D. C., OCTOBER 1936 No. 12

Jeff Casts a vote for...

Crop Insurance

Jeff McDermid

RAISING the subject of crop insurance may cause ardent admirers to quit quoting me for fear I may have joined the Something for Nothing party, which stands for all you can spend and a double bonus for bankruptcy. Still another set of friends may yet have faith in my intellect even after uncommonly high temperatures, but they will put a droopy wet blanket on any more dry talk—whether from the Weather Bureau, the American Economic Society, or the Prohibition party survivors.

And perhaps rightly so, for we have observed with alarm this summer (over sundry ice-cold concoctions) that there is a certain amount of "drought defeatism" psychology permeating the public press, causing some jittery souls to go into a panic over provisions. If this persists I shall expect them to give canned tomatoes and grape-nuts for bridge prizes, if we don't get a cloudburst before frost.

Howsumever, and just to be contrary, I intend to wade right into the puddles of tardy rainwater and hold aloft that underprivileged infant, crop insurance, so that it may not get washed away in the coming flood of old-age rewards, never-due loans, universal relief, and the gilt-edged nickel.

As a friend of crop insurance, I am assured before election that all parties are for it, which means that they don't know anything about it. I can't say I do either, which puts us all in an

equally receptive state of mind to draft a law which ought to last until we get another one.

In the words of the colored dialect writer, when you take up crop insurance coverage of a universal nature you talk about something "t'ain no sech thing as." When everybody needs it there isn't any, and when it isn't needed nobody wants it. It's talking about something conditional on weather vagary in terms of fixed equations.

BUT I think we can safely assume that ordinary risk companies and their actuaries (barring Doc Townsend and Lloyds of London) are going to sit in the Capitol galleries and give the government a pretty free field to test it out; and that before we set up monetary benefits on a national scale for staple crop insurance, a trial of the ever-normal granary proposal of making premiums and benefits payable in kind for the respective commodities must be expected.

The ever-normal granary intrigues us. It brings up the same old truism that the world often re-discovers means and methods under the common belief that they are new inventions. Sometimes a method used in a primitive state of society and then discarded may return to popularity among complex civilizations, under the pressure of fundamental human needs. Such is the ever-normal granary. This form of agricultural insurance is almost as old as agriculture. No present-day party can put a patent on it, but those who advocate it most have been smart enough to go back further than the Federal Farm Board to check upon government attempts to solve the surplus situation.

In the late seventies and eighties there lived a royal, Prussian, political science professor who made such a study of agricultural insurance in connection with rural credit and the remission of taxes that he was loaned to the Japanese government as what probably was the original "brain-truster." This learned savant, named P. Mayet of Tübingen, established the agricultural distress-fund law of Japan enacted in 1880 at the request of Count Okuma Shigenobu, minister of finance.

During the first five years this law aided 800,000 farm families with money for houses, implements, seed corn, and the payment of the land tax; and it provided three and a half million people with money for the necessaries of life. Mayet became an expert on Oriental famines caused by flood and drought, and out of his experience came a notable work of that day, translated from the German in 1893 by a Canadian doctor. It is from this old document that I find some of the traces of ever-normal granaries in the earliest eras of recorded history. Maybe some of the anxious legislators of 1937 may find a dip into Mayet of more than momentary interest.

NOT that I imagine that we have had or may have an actual famine in America, or that we could live on a few kokus of rice without kicking—but despite the meager conditions then and the luxury now, perhaps a germ of that policy may survive even as a kernel of wheat may send forth a green spear after centuries of sleep in the crypt of an ancient king.

Mayet says that funds to alleviate agricultural distress through reserve granaries may be traced from China through the early ages in Japan, with roots of the system extending into France, Westphalia, and the Rhine countries. He mentions five kinds of granaries.

First, the tax receiving granaries, where the people paid their obligations to the government in kind rather than in cash. During the Tang dynasty in China, or in the period about the year 750, there were 42,126,000 kokus of

rice stored in these tax bins. As one koku equals 4.96 bus. of our measure, we can see that the tax tithes of rice at that time amounted to some considerable heap. Funny no wise spellbinder has yet come out for payment of American farm taxes in bales of cotton or bushels of grain! Or have they?

In the second place, they had transport granaries or exchange piles of rice and other nonperishables, so that

the taxes might be carted from one province to another or taken to the capital when the big shots wanted an extra big banquet.

In the third instance occurred certain granaries used for steadying prices. They were filled by buying rice in cheap years and emptied by selling it in years of scarcity or in years of firm price levels. That is, they were intended to raise the price to growers in cheap years and to lower the price in dear years for the consumer benefit. We find this idea repeated by our friend, the Secretary of Agriculture, who knows that to have a contented nation we must preserve a balance between producer and consumer. Believe it or not, such price-stabilizing granaries existed as early as 55 B. C.

THESE price steadying bins were first introduced to Japan by Emperor Junjin Tenno, who bossed the little intrepids from A. D. 759 to 764. But with the growth of feudalism in the Middle Ages these systems disappeared. (Excuse me if I seem a trifle duller than usual in reciting dusty facts, but I may get somewhere if I keep on.)

Glimpsing the result when the price stabilizing bins were in the discard, say about 1321, under the rule of Emperor Godagio Tenno of Japan, we hear on good authority that this monarch had to use the sheepish expedient of a proclamation to the wealthy brokers and warehousemen, asking them to "please sell their extra stores of rice to the starving farmers and the poor." (This is surely far enough in antiquity not to get me boiled up in the present seething economic debate over who is to handle the swag from 1937 to 1941.)

NOW return with me to the fourth type of public rice bins. These were knowns as "village relief" granaries. They were filled by levying an extra tax in kind on rich harvesters and during years of abundance, in proportion to the crop surplus. Under the Sui dynasty of 589-618 all any one family had to fork over for these village heaps was one koku of barley or millet per annum. Then right in the very next reign, that of the Tang crowd, the annals state that the size of the landed property was taken as the scale for making village storehouse tithes. (Like the parties today, they both seemed to believe in agricultural relief but did a little experimenting here and there, and a few new wrinkles crept in—perhaps not without some grumbling over dictatorship.) Persons with land paid two "sho" (about 4.3 pints) of rice for each one tenth of one "tan" (a fortieth of an acre) which you may translate, if you have the time, into Yankee yields and doles.

The economic wizards of that long-ago epoch kept crop registers. When the harvests were 40% under the

(*Turn to page* 44)

Flower Symptoms Warn of Food Deficiency

By E. W. McElwee

Assistant Professor of Horticulture, Alabama Polytechnic Institute

THE intensive and restricted method used by the flower grower, whether florist or home flower grower, in growing flowers in beds, pots, and benches increases the possibility of damage to the plants from a deficiency of essential plant foods in the soil. The three essential nutrients most generally found deficient in the soil are nitrogen, phosphorus, and potash. A deficiency of one or more usually causes chlorosis, burning, spotting, or discoloration of the leaves of the affected plant. This damage is very important to the flower grower, because good foliage is essential to the proper appearance of the cut flower or pot plant. These deficiencies may also cause stunted plants and a lower yield of poor quality flowers.

The results presented here are from experiments conducted in the Department of Floriculture, Ohio State University, Columbus, in an effort to accurately establish the visual symptoms of plant-food deficiencies in a representative group of greenhouse crops. These symptoms are intended to serve as a guide in aiding the flower grower to diagnose nutritional troubles in time to correct them before they become acute. Several other conditions, such as overwatering, placing plants in drafts of cold air, sunscald, dry soil, insect injury, and spray injury, may cause a condition of the leaves similar to those given below for symptoms of nutrient deficiencies, and these possible causes must be eliminated before the condition can be attributed to a deficiency of plant food.

The experiments were conducted in a mixture of two-thirds sand blast and one-third fine quartz sand in glass pots to reduce the possibility of fixation of nutrients by the growing media and to eliminate the possibility of entrance of foreign nutrients. The complete nutrient solution used was adjusted to contain the following concentration of elements:

	P. P. M.
Nitrate (NO_3)	256
Phosphorus (P_2O_5)	65
Potassium (K_2O)	108
Calcium	30
Magnesium	28
Chlorine	74
Sulphur	28
Boron	1
Manganese	0.7
Iron	1.4

All other nutrient solutions contained identical concentrations except for the element omitted to give the deficient nutrient solution for a specific element. A constant renewal drip was used in supplying the nutrient solutions.

Begonia, Calceolaria, Cineraria, Fuchsia, Geranium, Rose, Primula, Poinsettia, Snapdragon, and Sweet Pea were used in the experiments, and the following nutrient deficiency symptoms were noted for nitrogen (N), phosphorus (P), and potassium (K).

Begonia

Complete—The plants were vigorous, growing plants with many flowers and normal, dark, glossy, green foliage.

Without Nitrogen—The plants were stunted in growth, with few flowers and brick-red foliage.

Without Phosphorus—The plants were normal in color but stunted and did not show any tendency to produce new side shoots.

Without Potash—The plants were almost normal in growth and color. The older leaves showed a definite burning along the margins, later turning brown and falling.

Calceolaria

Complete—The plants were large, with leaves of normal green color, and good flower cluster.

Without Nitrogen—The plants were very stunted in growth, and the flower cluster was small. The old leaves were almost white in color with light-brown, dead margins; and the young leaves were very pale yellowish green in color.

Without Phosphorus—The plants were very stunted in growth, of an unusually dark-green color, and without a flower cluster. The old leaves showed some yellowing around the margins.

Without Potash—The plants were only slightly stunted, but the flower cluster was poorly developed and the flowers faded in color. The older leaves were brittle, crinkled between the veins, and of a normal green color except for the affected areas. The margins of the older leaves and the area around the petiole died and dried to a dark-brown to black color, with the centers showing large spots with neurotic centers. The young leaves were light green to yellowish green in color.

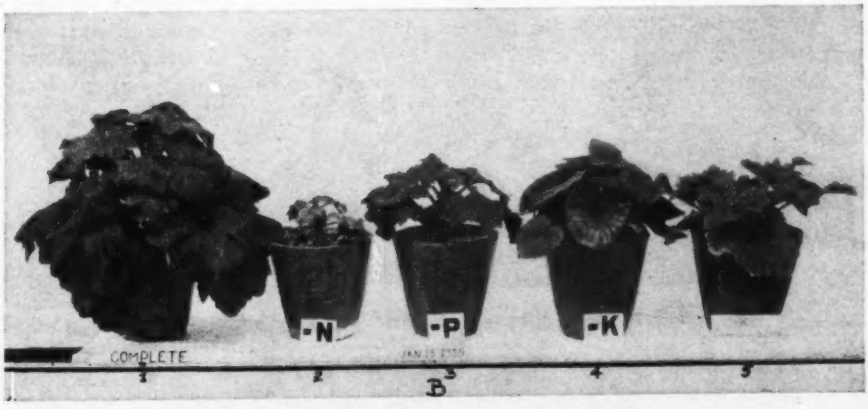
Cineraria

Complete—The plants were vigorous in growth with large leaves of a normal green color.

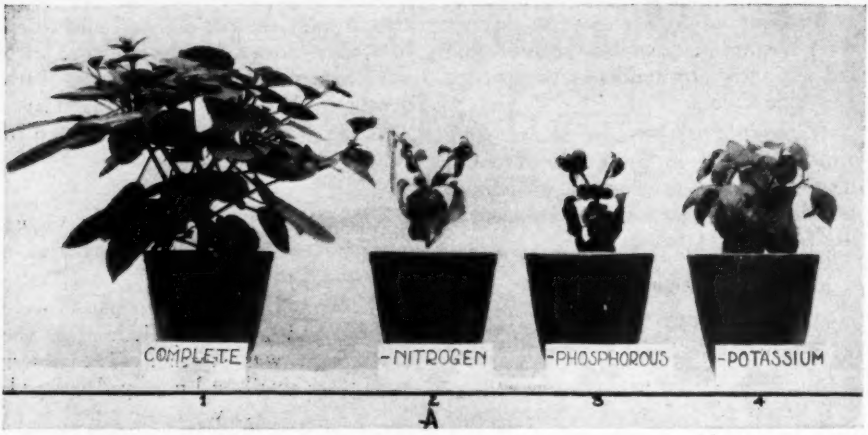
Without Nitrogen—The plants were stunted and grew very little after the experiment was started. The flower buds were small and poorly developed. All of the leaves were rusty yellow in color and remained attached to the plant for a long time after drying.

Without Phosphorus—The plants were about one-half as large as the check plants, with smaller leaves of an abnormally dark-green color above and tinged with purple beneath. The older leaves began to turn yellow and die, but usually dropped before becoming completely yellow.

Without Potash—The plants were slightly stunted in growth. The older leaves were mottled with whitish-yellow markings between the veins and along the margins of the leaf. The margins later turned brown. All the leaves in this treatment showed a deep purple color on the underside as distinguished from the purplish tinge exhibited by those without phosphorus.



No. 5 shows the recovery of the Cineraria from acute potassium deficiency symptoms in 6 weeks after receiving a complete nutrient solution.



Nutrient deficiency symptoms for the Fuchsia.

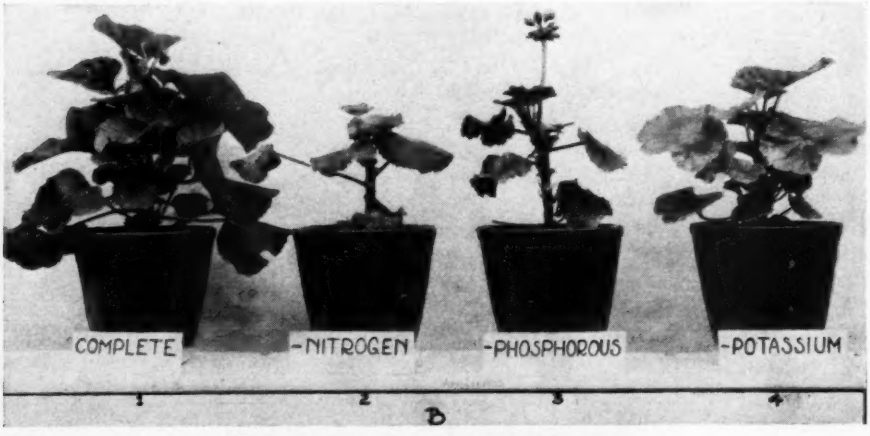
Fuchsia

Complete—The plants were vigorous in growth, dark green in color, with large flower clusters, and showed a quick response in producing new growth after being pinched.

Without Nitrogen—The plants were very stunted and produced only two new shoots after the first pinching. All of the leaves gradually turned yellowish green in color, and the older leaves finally turned to an orange color and dropped before completely dying. The plants produced a flower cluster prematurely with abnormal flowers.

Without Phosphorus—The plants were very stunted in growth. The older leaves were of an abnormally dark-green color, and the young leaves of a bronze-purple color, crinkled, and rosetted. The plants did not lose their foliage or produce flower buds before the experiment ended.

Without Potash—The plants were only partially stunted in producing shoots after pinching. The older leaves were dark green in color and showed some browning in spots between the veins and along the margin of the leaf. The young leaves were slightly yel-



Geranium exhibiting plant-food deficiencies.

lowish green in color and rolled inward along the margins.

Geranium

Complete—The plants were vigorous-growing and well branched. The leaves were of a normal green color with very little indication of the colored ring on the leaf.

Without Nitrogen—The plants were very stunted in growth, with only a central stem and no flower clusters. The young leaves were very light green in color with a definite reddish-bronze ring around the center. The older leaves turned a brilliant red except for a yellowish-red area around the petiole, dried up, and remained attached to the plant for some time.

Without Phosphorus—The plants were stunted almost as much as those in the treatment without nitrogen, but showed a well-developed flower cluster of good color. The young leaves were dark green in color and showed a distinct chocolate-brown ring around the center. The older leaves turned a dull, dark red, progressing from the margin toward the petiole, and dried and dropped from the plant early.

Without Potash—The plants were only slightly smaller than those in the check treatment and produced several side branches and flower clusters. The young leaves were a pale, yellowish-green color with dark-green veins. The older leaves were grayish yellow between the veins and along the margins, with some yellow and brown spotting between the veins, and showed a distinct, rusty-brown ring around the center. There was some yellowing and brown spotting between the veins of the old leaves.

Rose

Complete — The plants produced long, vigorous shoots with many side shoots and flower buds and leaves of a normal, dark-green color.

Without Nitrogen—The plants were very stunted in growth and did not show any tendency to produce new bottom shoots. The foliage was yellowish green in color, stiff, and brittle.

Without Phosphorus—The plants produced a few new shoots that did not produce flower buds. The foliage was grayish green in color. This differs from the other plants studied, most of which showed an unusually dark green color in the treatment without phosphorus.

Without Potash—The plants produced several new shoots after pinching early in the experiment. This tendency to produce new shoots decreased later, and the total growth was reduced. The foliage was lighter green than normal, and the older leaves showed light colored spots between the veins and dark-green veins. The new leaves were bright red in color but showed the same spotting between the veins as shown by the old leaves.

Poinsettia

Complete—The plants were vigorous in growth, of a normal, dark-green color, and showed no loss of leaves.

Without Nitrogen — The plants showed a uniform yellowing of all leaves, beginning with the bottom leaves and progressing to the top leaves. The older leaves turned pale yellow and dropped before becoming completely dead.

Without Phosphorus—The plants grew very little after being placed on this treatment. The older leaves began yellowing from the margins toward the center of the leaf and dropped before becoming completely yellow. All leaves dropped in succession until only the young bud leaves remained, which were very dark green in color.

Without Potash—The plants were only partially stunted in growth. The older leaves began to turn yellow along the margins, and finally the entire leaf turned yellow except the veins which remained dark green in color. Browning along the margin began after the leaves became completely yellow, and the leaves remained attached to the

plant for some time after dying. All the leaves were finally affected except the young bud leaves at the tip. These remained dark green in color after most of the other leaves were yellow or dead. The plants produced several side branches that developed normally for a short time and then began to turn yellow and turn brown along the margins.

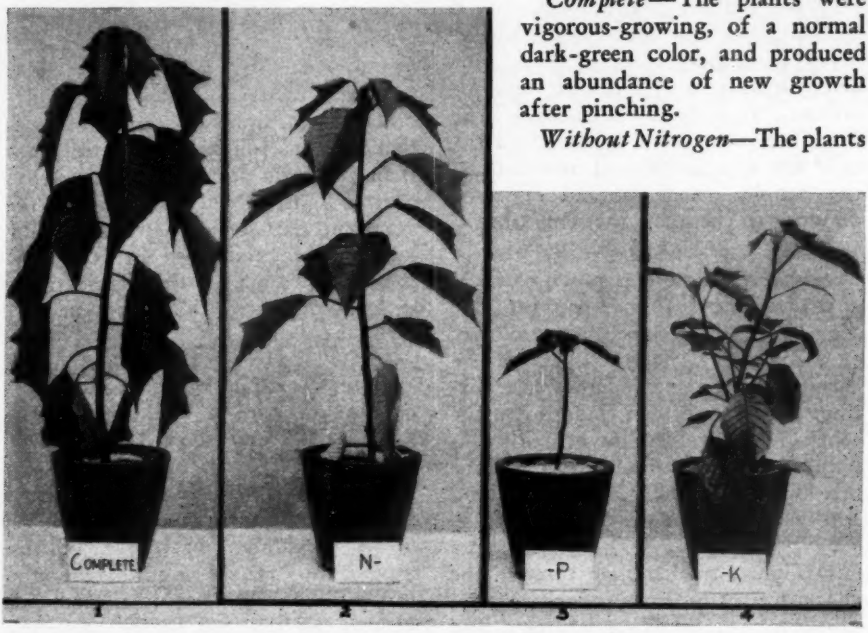
Without Potash—The plants were almost normal in size with a normal flower cluster that was faded in color. The young leaves were normal in color, but the older leaves were yellow in spots over the leaf and along the margin. The veins of the affected leaves remained green until the leaf died.

Snapdragon

Complete—The plants were vigorous-growing, of a normal dark-green color, and produced an abundance of new growth after pinching.

Without Nitrogen—The plants were very stunted in growth and did not produce new shoots except after the first pinching. The young leaves were light green in color with some yellowing along the margins and between the veins. The old leaves were rusty-yellow to rusty-yellowish-green color. After dying, the old leaves remained a rusty color and clung to the plant for some time.

Without Phosphorus—The plants were stunted as much as those in the minus-nitrogen treatment but differed in being unusually dark green in color.



Poinsettia nutrient deficiency symptoms. The —N test plants were first grown in a complete nutrient solution to obtain enough leaves to show the definite —N deficiency symptoms.

Primula

Complete—The plants were normal dark green in color with a well-developed flower cluster.

Without Nitrogen—The plants were very stunted in growth with all the leaves small and light yellowish-green in color and showed no indication of flowering.

Without Phosphorus—The plants were normal in size but without a flower cluster. The leaves were an abnormally dark-green color, deeply crimped, and yellow along the margins.

(*Turn to page* 39)

Potassium Availability in Illinois Soils

By R. H. Bray

Soil Analyst, University of Illinois, Urbana, Illinois

THE facts of research when viewed separately are often so dry and uninteresting that it is useless to try to interest others in them. Occasionally, however, the facts fit together like the pieces of a jigsaw puzzle and give a clear-cut picture, interesting to both the layman and the scientist. We believe this to be the case with our researches into potassium availability pursued at the Illinois Agricultural Experiment Station and presented in part at the Chicago meeting of the American Society of Agronomy, December 1935, by E. E. DeTurk and the writer.

Within the last few years these pieces representing isolated facts have been fitting together, giving us a picture of potassium availability which has explained the significance of many facts formerly known but not clearly understood. That some of the results can be applied to a wide variety of soils is, no doubt, true, but others may be limited in their application to soils similar to the soils of the corn belt included in the study.

Terms Defined

First, let us begin without apologizing for using the term "available potassium." It is a good term, one we have been brought up with; and even though it never has been clearly defined, it always puts over the idea we are trying to express as no other term can. We know now that so far as our soils are concerned "available potassium" is practically synonymous with "replaceable potassium," and that practically speaking the amount of replaceable potassium present at planting time determines the crops' need for extra potassium in the form of fertilizers.

We found this out by comparing the amount of replaceable potassium present on the RLP plots* of 25 different soil experiment fields, representing as many or more soil types with the response to applied potash on the RLPK plots. On all fields that averaged around 140 pounds or more of replaceable potassium per acre in 2,000,000 pounds of surface soil, the crop increase for potash fertilizer did not pay for the potash used. All fields which averaged less than 90 pounds of available potassium per acre gave a profitable response to potash. Fields averaging between 90 and 140 pounds gave erratic responses, although in general the responses were profitable. This calibration holds for the silt loam and clay loam soils of Illinois.

This checking against the experimental field plots of known performance was started in the fall of 1930 and the spring of 1931, and the data secured seemed sufficiently convincing to warrant beginning the use of this information as a basis for potash recommendations. However, Plot No. 108 and No. 308 of the Dixon field did not give a high test (140 pounds or over), and since the Dixon field had never responded significantly to

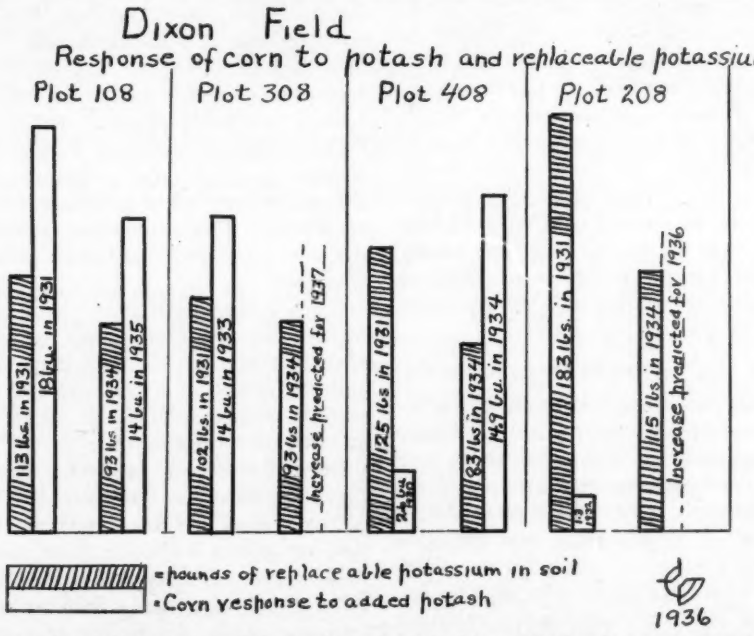
* R=residues; L=limestone; P=rock or superphosphate; K=potash as kainite.

potash, and as it represented one of our important soil types supposed to be inexhaustible as far as potash was concerned, we held up the release of the soil test we had devised to measure the replaceable potassium until the crop returns were in for the fall of 1931. Of course, we were gratified to obtain an 18-bushel increase in corn on the No. 109 plot and a 0.54-ton increase in clover on No. 309, and no significant increases on the other two plots testing high in replaceable potassium. Those two responding plots, 109 and 309, have continued ever since to be responsive to potash for the corn and clover crops.

This experience, together with the data from the other fields, satisfied us that the total amount of replaceable potassium was the one thing to measure in order to separate the low responders from the high responders. We have accordingly been recommending the use of our test, which measures the replaceable potash present, along with any which is water-soluble, as the first step to be taken in determining the need for potash in Illinois soils.

Interpreting Results

Since our farmers and farm advisers were mostly interested in the grain and hay crops, we adjusted the ratio of extracting solution to the size of soil sample used in the test, so that the test would give a high reading on the potash-rich soils, a low reading on the deficient soils, and a medium reading on the semi-deficient soils. This was called our 10-10 calibration, and it involved a direct reading in terms of crop response. It is also possible, by means of a scale we have prepared, to read the test in terms of pounds per acre from 40 pounds up with practically quantitative accuracy. We have confidence that with sufficient work calibrations can be found for other crops so that "pounds per acre" can be interpreted. Merely knowing



This map shows that over a period of only 5 years the Dixon field has been converted from a non-responsive to a potash-responsive field, and the decrease in the replaceable potassium values reveals the reason for this.

the "pounds per acre" present without its significance in crop response is not sufficient. To establish this significance is just as much the work of the crops man as it is of the soils man.

Now let us consider some other aspects of the potassium fertility problem. Are we justified, for example, in calling the replaceable potassium the "available potassium"? Another way of stating this question is, "does the amount of replaceable potassium so dominate potassium fertility that other factors are of minor importance?" We believe that "yes" is the answer to this.

There are other sources of potassium besides that which is replaceable. A very small amount occurring in the soil solution need not be considered since it is measured along with the replaceable potassium. This leaves the potash minerals as the only other source of supply. Potash minerals are not soluble; they have to decompose or alter to new forms before the potash becomes liberated. This is the reason why farming practices, such as green manuring, have little if any effect on potash liberation.

Duration of Richness

The rate of liberation from the mineral forms determines the continued potash richness of the soil. A high rate of liberation will maintain a high level of replaceable potash, and vice versa. Withdrawal of replaceable potassium by the crop may speed up this rate. In general, the rate of supply of available potassium through the alteration of minerals on many of our soils which are not deficient is just about enough to keep the soils out of the deficient class, as shown by the fact that the level of replaceable potassium present is often very close to the critical level (140 pounds). Only a minor part of this new supply which is being slowly liberated from the minerals is available to this year's crop, as will be shown later. This leaves the replaceable potassium as the largest source of available potassium for the plant.

Replaceable Potassium

Another factor to be considered is the availability of the replaceable or available potassium. The idea that the term "available" implies 100 per cent availability is not correct. Attempts to measure directly the availability of a fertility element by chemical tests alone must result in failure, even though the form being measured is the only form present. The reason for this is that the plant itself has a voice to be heard in establishing the availability of a given form of plant food. By cooperative work with Dr. S. F. Thornton, of the Purdue Experiment Station, we have established the fact that, regardless of the magnitude of the base-exchange capacity or amounts of replaceable magnesium, calcium, or hydrogen present in our soils, the replaceable potash is, under the conditions of the Neubauer pot-test method, 100 per cent available. On some potash-treated soils even more than the replaceable potassium was removed by the plants grown in Neubauer tests.

Why, then, do we say that around 140 pounds of replaceable potassium per acre is necessary in the surface 7 inches of soil for our hay and grain crops, when the crop may actually require only 30 to 60 pounds, which it obtains from the soil area contacted by its roots? The answer is that while complete, effective contact of the replaceable potash may result under the conditions of the Neubauer method which was designed especially for this purpose, effective contact of the root system of a crop with the whole soil mass does not occur in the field.

I use the term "effective contact" because the feeding roots actually contact only an extremely small amount of the surfaces of the soil colloids where this reserve supply of replace-

able potassium resides; and the great bulk of the replaceable potassium taken up by the roots has had to go through the soil for some distance in the dissolved condition before contacting the feeding roots. The effective distance these ions can travel is limited. We must, therefore, consider the replaceable potassium as 100 per cent physiologically and chemically available, with its "positional availability," to use a term applied by Spencer and Stewart to an old concept, varying according to root development, nature of the soil solution, and other factors.

Positional Availability

The effecive positional availability of replaceable potassium, theoretically, can be calculated for a given plant. The largest factors concerned are usually the rooting system and water relationships during a given season. Let us take corn as an example and assume an average requirement of 1 pound of potash per bushel of corn produced. Our better soils produce 60 bushels an acre without added potash and have present 140 or more pounds of replaceable potash in the surface-plowed layer. Using the surface 14 inches as the average feeding range, this makes 280 pounds of replaceable potash present that might be drawn upon. The 60 pounds taken up by the corn is 21 per cent of the total amount present, or an average positional availability of 21 per cent.

The soils in our semi-deficient areas average around 230 pounds in the first 14 inches and yield around 52 bushels. That represents an average positional availability of 23 per cent.

The soils in our deficient areas average around 120 pounds and yield around 30 bushels, showing a 25 per cent positional availability. Although these percentages are based on an assumed utilization of 1 pound of potash per bushel of corn, they illustrate the principle involved, and the values necessary for accurate calculations can all be obtained. Furthermore, the above relation between the corn yield and replaceable potassium is a relationship based on actual determinations involving no assumptions.

We can now see why the rate of supply of available potassium from the potash minerals, although important to next year's crops, is of very small importance to the present crop. In the first place, the plant roots effectively contact only a limited soil area. Next, they contact this only for a limited time. To be of practical importance the supply from the potash minerals in this limited area and limited time must be very much greater than appears at present to be the case. In the above case, about 20 per cent of the soil area would have to supply 60 pounds of potash during four months of the year. This would be equivalent to 600 pounds in the whole soil area during the eight months of open weather. Our studies indicate no such large rate of supply of potash to the replaceable condition from the soil minerals; in fact, the soil does well to replace the amount lost each year.

As I have said, the renewal from the minerals is important to next year's crops because, while the plants are feeding in the area effectively contacted by the roots, this renewal is going on, not only in the contacted area but also in the non-contacted area. For this reason the decrease in replaceable potassium during crop growth is not as great as might be expected, since some renewal is always occurring. This is one of the reasons why pot experiments cannot be directly interpreted in terms of field behavior; i. e., the positional availability and associated relationships are not the same in the two cases.

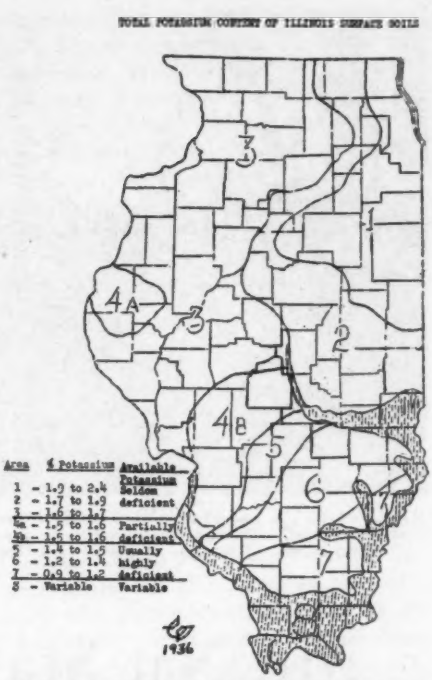
Plowing the land mixes the root-contacted and non-contacted areas leaving, in general, the replaceable potassium fairly well distributed throughout the soilmass, except in

the vicinity of organic residues which still have potash to be released.

Potassium in crop residues, manures, or added in fertilizers is not evenly distributed throughout the soil but is almost all fixed in the replaceable form in the soil area which first receives it. For this reason it will have an increased positional availability over the well-distributed, original replaceable potassium, provided the plant roots contact these areas in which the potash is more concentrated. This, of course, is the basis for "hill-dropped" fertilization. This difference in the availability, however, does not interfere in the calibration of our test, since we test the soil before planting the crop and adding the potash fertilizers, not afterward. Before the next year's planting time comes around, cutivation and plowing will have distributed the added potash, more or less, throughout the surface soil. Since our test is calibrated against crop response as well as pounds per acre, we do not have to concern ourselves especially with the positional availability of the naturally occurring replaceable potash or that from the residues of last year's potash application, as the calibration takes this into account.

Determining Factors

The crops grown, as well as the level of productivity of the soil, with respect to other plant-food elements or conditions which could limit the yield, determine the level of replaceable potassium required. Since corn requires the highest level, clover next, and wheat and oats the lowest, we consider a soil to be potash-deficient when corn begins to give profitable responses to potash applications, but only on the low-testing soils (90 pounds or less) do we regard potash generally necessary for all crops. The level of replaceable potassium necessary for any given crop varies both with that crop's needs and its ability to go and get it. These levels for the different


TOTAL POTASSIUM CONTENT OF ILLINOIS SURFACE SOILS
Area
% Potassium
Available Potassium Seldom deficient
1 - 1.9 to 2.4
2 - 1.7 to 1.9
3 - 1.6 to 1.7
4a - 1.5 to 1.6 Partially
4b - 1.5 to 1.6 deficient
5 - 1.4 to 1.5 Usually
6 - 1.2 to 1.4 highly
7 - 0.9 to 1.2 deficient
8 - Variable Variable
1936

The map shows areas deficient in potash, areas which will soon become deficient, and areas where potassium deficiencies will not generally occur in the near future, although a few deficiencies have shown up in local areas.

crops will have to be established under practical conditions. We can see, therefore, that although different levels may be required by different crops, the amount of replaceable potassium still remains the measure of "available" potassium.

There are other factors which we have not considered as yet. For example, does liming affect the replaceable potassium in any way? The Neubauer tests told us that liming did not affect in any way the availability to the plant under Neubauer conditions of the replaceable potassium present. Other work we have done indicates that liming will help decrease leaching loss of replaceable potassium without any practical decrease in its availability in the field. Still other work has shown that saturating a soil with calcium does not

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Here's where the phosphate-potash mixture ran out, showing a remarkable difference. Same seed, same land, same cultivation, and same amount of superphosphate, but the corn on the left had 25 lbs. of muriate of potash in addition to the 175 lbs. of 16% superphosphate.

Mr. Nat Stafford Learns About Potash

By F. H. Jeter

North Carolina State College of Agriculture

ONE knew instinctively that Mr. Stafford was a bachelor. There was an air of competent untidiness about the place which proclaimed this in terms not to be misunderstood.

Mr. Stafford lives in the old home house back from the main road in about the center of the 108 acres which became his part of the ancestral estate. He takes his meals with a married sister who lives in a modern home up on the highway. This newer home has a beautiful lawn and well kept grounds. Where Mr. Stafford lives is—well, not so nicely kept.

As one walked with him about over his farm, the impression persisted that he was not so concerned about how his place appeared to eyes of the visitor, but rather he was concerned with the profits which it would produce. His full name is T. N. Stafford, but he is known as "Mr. Nat" and he lives on rural route 1 from Graham in Alamance County. He is 60 years of age and a sturdy member of an excellent family.

N. C. Shiver, county agent of Alamance County, says "Mr. Nat" has made money on the farm and, in a quiet way, has promoted soil building and dairy cattle in the community. He has saved money and has helped his sister's children in obtaining blooded

Jersey calves of their own in order to become members of the well-known Alamance 4-H Jersey Calf Club. It is a pleasure to walk with him over the old home place and hear simple tales of his boyhood, and of the efforts to win a living from the old worn-out, washed fields of the family farm.

Practices Rotation

Mr. Nat makes more corn and wheat on a small field than his widowed mother made on her whole place. He learned about lespedeza and crop rotations a good many years ago, and largely through these he has built his soil. There are only 59 of the 108 acres in yearly cultivation, and these are planted to corn, oats, wheat, and lespedeza.

"My rotation is corn the first year, followed by wheat over which I sow lespedeza in the late winter," Mr. Nat said. "I mow this lespedeza for hay in the fall or gather the seed and then pasture it the next year. I grow no cotton or tobacco."

Mr. Stafford said his main income is from the sale of lespedeza seed and wheat. He keeps two heavy brood mares and sometimes has a colt or two for sale, and he also owns about 10 milk cows that he rents for cash and sells the calves. Some of the young animals are sold for veal on the nearby Burlington market. Being a bachelor there is no need for milk in his establishment, but since he has plenty of pasture, largely based on lespedeza and orchard grass, there is ample grazing for the cattle. A tractor is used to do the heavy plowing in preparing the land for seeding, and the two brood mares handle the work for the remainder of the year. Occasionally, Mr. Stafford rents out a small acreage to a neighbor who may need additional crop land. The soil is principally of the Alamance Loam, a slaty soil, on which lespedeza flourishes and which benefits greatly through the legume.

To be strictly truthful it must be recorded that Mr. Stafford knows very little about fertilizers in the sense that the great plantation owners of eastern Carolina know about them. But he is learning fast, and in a measure he is stumbling upon some valuable facts. He stumbled upon one such fact during the crop season of 1936, and that was the reason for my visit.

Five years ago, he planted a field of 25 acres to corn. The corn was followed by spring oats, and then the field was planted to lespedeza to be mowed the first two years and grazed for the following three years. Believing that the land was then ready to go back under the plow, Mr. Stafford broke the field thoroughly with his tractor in early April and made ready to plant corn. However, it was unusually dry in North Carolina during the spring of 1936, and so the corn was not planted until June. As he waited for the rains to make planting possible, Mr. Stafford mixed about 175 to 200 lbs. of 16% superphosphate with 25 lbs. of muriate of potash to go under his corn. He used no nitrogen because the land had been in lespedeza pasturage for several years.

Accidental Experiment

Anyway, the rains came unexpectedly, and in the rush to plant Mr. Stafford had only enough of the phosphate-potash mixture ready for about two thirds of his field. When the mixture ran out, he continued his plantings using the phosphate alone, until the whole field was seeded. In the extreme end of the field, however, where no potash was used, he did manage to get some manure broadcasted.

"I ran out of a job one day, and while the boys were plowing I threw 10 quarts of the muriate of potash on parts of 6 or 7 rows ahead of the plows. The corn was then about knee high," he said.

All the while I was learning these

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Potash for Cotton Wilt in the Mississippi Delta Region

By Dr. L. E. Miles

Agricultural Experiment Station, State College, Mississippi

COTTON wilt caused by *Fusarium vasinfectum* is usually of but minor importance in the Yazoo-Mississippi Delta. The soils of that area are in the main of a rather heavy nature, in which the organism does not thrive and spread rapidly. However, in certain localities in the Delta, local areas occur in which the soil is of a different nature, and in some of these Fusarium wilt is found to do a great deal of damage. These areas may be of small size, making up only a part of a field, or they may extend for considerable distances.

The wilt situation is complicated somewhat in the Delta by the presence there of a second type of cotton wilt caused by another fungus, *Verticillium dahliae* Kleb. These two wilts are very similar in their symptoms and are difficult to differentiate under field conditions. This second wilt occurs more commonly on the heavier soil types, though it may sometimes be found on lighter soils as well. The presence of the two in the same localities makes it compulsory to determine which may be responsible for the damage inflicted, since they do not respond to the same control measures.

In 1931 experimental tests were begun in three areas in different parts of the Delta to determine the effect, if any, that potash might have in the control of wilt under the respective conditions pertaining to each. The test was continued for three years in two of these localities and for two years in the other. As a preliminary measure it was first carefully determined that the damage present was due to the Fusarium wilt and not to the one caused by Verticillium.

Tests Supply Data

The first test to be reported was located near Paynes, Miss., on the property of Spencer J. Brown, Cascilla, Miss. This was in the eastern edge of the Delta, within one half mile of the abrupt bluffs which limit it at that point. The soil was not typical of the Delta but was a brown silt loam, similar in characteristics to that found on the bluffs above it. In fact, there is little doubt but that it originated in that upland area and was removed and deposited in its present position by the action of water erosion. Cotton wilt was generally prevalent and destructive throughout all the strip of land on the eastern edge of the Delta adjacent to the bluffs, as was also the condition commonly known as rust or "potash hunger."

Two fertilizer elements only were used, namely, nitrate of soda and muriate of potash, though it is extremely probable that phosphate also would have been beneficial from the standpoint of yields, since it has proven so on the uplands immediately adjacent which possess similar soils. The gen-

eral fertilizer practice of the area, however, has followed that of the remainder of the Delta in the use of nitrate alone, if any fertilizer at all was used. It was considered advisable, therefore, to eliminate phosphate from the test in order to avoid possible confusion in the interpretation of results.

Each plat consisted of 10 rows, 218 ft. long, and constituted one sixth acre. One plat served as a check and received no fertilizer. Another received 200 lbs. of nitrate of soda. Two others received the 200 lbs. of nitrate and in addition muriate of potash to the amounts of 50 and 100 lbs. per acre, respectively. Three other plats received no nitrate but were given respective per-acre applications of 50, 100, and 200 lbs. of muriate of potash alone. Each treatment was replicated three times with the exception of the 200-lb. application of potash, which occurred only once and was omitted entirely in 1931. The fertilizer was weighed and applied by hand on March 22, 1931, and the cotton was planted two weeks later on April 5. In 1932 the fertilizer was applied in the same manner on April 20, and the cotton was planted the same day. In 1933 the fertilization and planting were done on April 11. The cotton used was the same each year, namely, Missdel No. 2, which is a quite susceptible variety.

Wilt counts were taken three times in each of the three years. The first was made about the middle of July. At this time any plant which showed any typical sympton of wilt was recorded as infected. Any plant which was so badly infected that it seemed probable that it might not survive until the next count was removed and so recorded. This was done in order that such plants might not be lost and that they might appear in subsequent counts and in the final record. Another count was made in a similar manner approximately one month later. The final count was made as soon as harvest was completed, somewhere between the first and middle of October. At that time 400 stalks were cut in each plat, and the percentage of infection was determined from those which showed typical discoloration of the vascular tissues. The 400 stalks were taken from certain

This plat shows the effect of no fertilizer (left) in contrast to the use of 200 lbs. of muriate of potash (right).

definite areas, uniformly distributed over the plat, and their locations were the same in each plat respectively.

The results are presented in table I. Wilt counts showed a comparatively light infection in July over all plats, the heaviest being on the check plat and on the one which had received nitrate of soda but no potash. In August of each year the infection was found to have increased greatly in all plats. It was still much heavier on the check plat and the nitrate of soda plat, being approximately the same on each. Infection was very materially lower on those receiving muriate of potash, the lowest occurring on those receiving 200 lbs. of nitrate of soda and 100 lbs. of potash and on the one receiving 200 lbs. of potash alone. At the final count in October the percentage of infection was higher but was relatively in the same proportion as in the August count. The average of the October or final count for the 3-year period showed 45.45% infection for the check or unfertilized plat and 40.35% for the one receiving 200 lbs. of nitrate of soda alone. The plat receiving 200 lbs. of potash alone showed the lowest wilt infection for the 2-year period in which it was included. It will be recalled that this plat was not replicated as were all the others. The next lowest infection was recorded on the plat treated with 200 lbs. of nitrate of soda and 100 lbs. of potash. Its wilt percentage for the period of the test was 16.05%, while that for the 200-lb. application of muriate of potash was 15.25%.

The highest average yield of seed cotton, 1,072 lbs. per acre, was recorded on the plat receiving 200 lbs. of nitrate of soda and 100 lbs. of potash. The plats receiving 200 lbs. of soda and 50 lbs. of potash, and 200 lbs. of soda alone, were tied for second place for the 3-year period with a yield of 992 lbs. The plats to which

TABLE I. SECTION A. WILT FERTILIZER TEST. PROPERTY OF S. J. BROWN, CASCILLA, 1931-1933

Treatment	Percent wilt infection								
	1931			1932			1933		
	July	Aug.	Oct.	July	Aug.	Oct.	July	Aug.	Oct.
Check no fertilizer	6.4	33.7	52.50	5.7	30.1	42.7	5.8	28.4	41.16
Nitrate of soda—200 lbs	6.3	30.0	40.28	6.1	30.7	44.5	7.1	24.1	36.30
Nitrate of soda—200 lbs. and muriate of potash—100 lbs.	2.8	9.8	15.07	2.3	8.2	14.5	2.1	8.0	18.61
Nitrate of soda—200 lbs. and muriate of potash—50 lbs.	2.5	12.1	20.54	3.4	11.6	23.5	2.8	10.3	22.83
Muriate of potash—50 lbs	3.7	15.0	26.58	4.4	13.3	25.5	4.3	10.1	25.00
Muriate of potash—100 lbs	3.5	13.7	24.53	3.0	10.1	23.0	3.7	11.6	25.67
Muriate of potash—200 lbs	..	...	....	2.9	9.2	14.0	1.6	6.8	16.50

TABLE I-a

Treatment	Av. pct. wilt infection			Lbs. seed cotton per acre			
	July	Aug.	Oct.	1931	1932	1933	Av.
Check no fertilizer	5.8	30.73	45.45	1,002	648	590	746
Nitrate of soda—200 lbs	6.5	28.26	40.36	1,234	842	900	992
Nitrate of soda—200 lbs. and muriate of potash—100 lbs	2.4	8.66	16.06	1,194	870	1,164	1,076
Nitrate of soda—200 lbs. and muriate of potash—50 lbs	2.9	11.33	22.29	1,190	826	962	992
Muriate of potash—50 lbs	4.1	12.80	25.35	1,028	726	714	822
Muriate of potash—100 lbs	2.4	11.80	24.40	1,022	760	744	842
Muriate of potash—200 lbs.	2.2	8.00	15.25	....	750	804	777

potash alone was applied ranked lower in yield than either those receiving nitrate alone or those receiving nitrate and potash combined. Though the plat treated with 200 lbs. of potash alone showed the lowest percentage of wilt for the two years in which it was included, the yield, 777 lbs., was second lowest in the entire series, that of the check plat alone being lower. However, if the average yield for the same two years is taken without reference to 1931, it is found that both the other plats receiving potash alone have lower yields than it. As compared with the 777 lbs. for the 200 lbs. of potash plat, it will be found that the yields for the same two years for the plats receiving 50 and 100 lbs. of potash, respectively, were 720 and 750 lbs.

The plat on the left received 200 lbs. of kainit, while that on the right received no fertilizer.

This test showed that a combination of 200 lbs. of nitrate of soda and 100 lbs. of muriate of potash per acre gave best results in the control of wilt as reflected in the percentage of infection and the yield of seed cotton. Fifty lbs. of muriate of potash in combination with 200 lbs. of nitrate of soda seemed to provide an insufficient amount of potash. The 200-lb. application of nitrate alone, though it produced very vigorous plants, showed a very high percentage of wilt which was reflected in the yield. On the other hand, applications of potash alone, though giving considerable reduction in wilt infection, failed to produce correspondingly increased yields. Even with the most favorable rate of application of both nitrate and potash in combination, the percentage of wilt infection was rather high for the 3-year period. This would indicate that on land as severely infested with wilt as was that used in this test, in addition to the use of a fertilizer mixture containing a sufficient amount of potash in combination with other necessary elements, a wilt-resistant variety of cotton should be planted as well. It is, of course, possible that inclusion of phosphate in the fertilizer mixture might have further reduced the amount of wilt infection by more adequately balancing the essential fertilizer elements.

The same test reported above was repeated on the property of F. T. Withers, Lake Cormorant, Miss. The

plats were located on land which is within the Mississippi Delta area but very near the northeastern edge. The soil differed somewhat from the typical Delta soil in that it had more of a loess character, derived from the adjacent hill lands on the east which limit the Delta at that point. On account of the fact that wilt failed to develop to a sufficient extent in 1931, the location of the plats was changed in 1932 to another field on the same property, in which it was observed that the trouble was much more uniformly distributed and severe. The results secured in 1931 are, therefore, omitted, and only those for 1932 and 1933 are presented.

In 1932 the fertilizer was weighed out and applied by hand on April 10. The cotton, Missdel No. 2, was planted the same day. A good stand was not secured and all plats were replanted on April 21. In 1933 the fertilizer was applied two weeks in advance of planting. The lay-out of the plats was the same as in the test previously reported. Wilt counts were taken three times during the season as in the previous case. The results secured are reported in table II.

On July 14 wilt was found to be showing up fairly abundantly for so early in the season. Infection, however, was much more evident and severe on the check plat, and on the plat which had received nitrate but no potash, than on any of those which had received potash. This same thing was found to be true in the July count in 1933. At the second wilt count in August rust was quite prevalent on the check and nitrate plats. As shown by the table, wilt infection on these two plats was practically the same for the 2-year period. Infection on the other plats which had received

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TABLE II. SECTION A. WILT FERTILIZER TEST. PROPERTY OF F. T. WITHERS, LAKE CORMORANT, MISS., 1932-1933

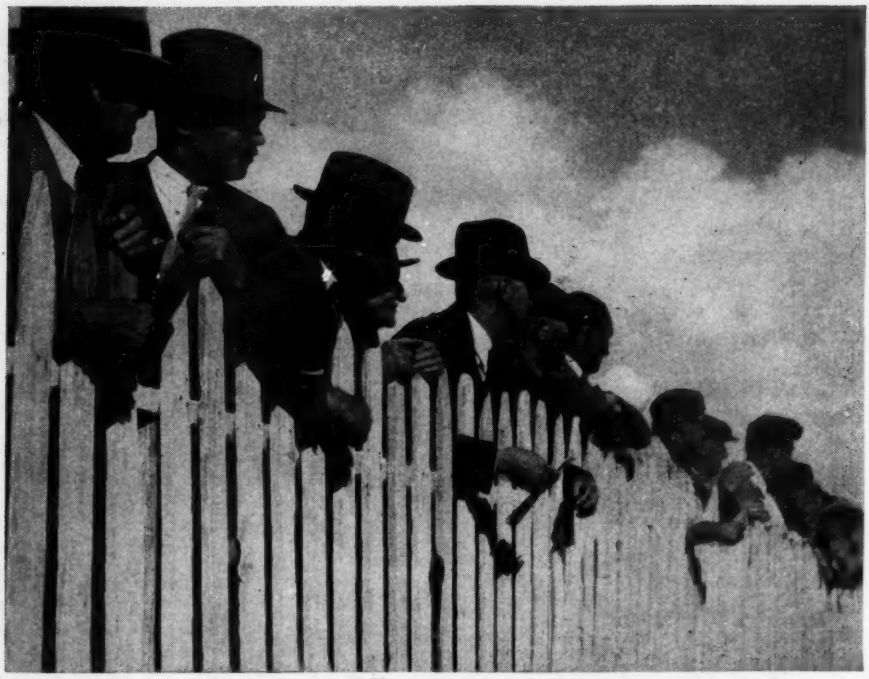
Treatment	Pct. wilt infection 1932 July	1932 Aug.	1932 Oct.	1933 July	1933 Aug.	1933 Oct.
Check no fertilizer	8.7	30.2	43.5	8.1	29.7	45.00
Nitrate of soda—200 lbs	6.9	30.7	45.0	5.9	24.1	34.67
Nitrate of soda—200 lbs. and muriate of potash—100 lbs.	2.0	6.9	11.0	2.4	7.3	11.33
Nitrate of soda—200 lbs. and muriate of potash—50 lbs.	3.5	13.3	18.3	2.9	10.1	15.00
Muriate of potash—50 lbs	3.4	11.7	17.0	3.4	13.2	17.33
Muriate of potash—100 lbs	3.0	10.3	13.3	3.4	14.9	20.33
Muriate of potash—200 lbs	2.1	6.6	9.0	3.0	14.4	21.00

TABLE II-a

Treatment	Pct. wilt infection 2-year av. July	Aug.	Oct.	Lbs. seed cotton per acre 1932	1933	2-year av.
Check no fertilizer	8.4	29.9	44.25	836	1,134	985
Nitrate of soda—200 lbs	6.4	27.4	39.83	739	1,369	1,054
Nitrate of soda—200 lbs. and muriate of potash—100 lbs	2.2	7.1	11.17	1,146	1,458	1,302
Nitrate of soda—200 lbs. and muriate of potash—50 lbs	3.2	11.7	16.67	1,106	1,406	1,256
Muriate of potash—50 lbs.	3.4	12.4	17.67	873	1,211	1,042
Muriate of potash—100 lbs.	3.2	12.6	16.81	1,012	1,114	1,063
Muriate of potash—200 lbs.	2.6	10.5	15.00	1,039	1,037	1,038

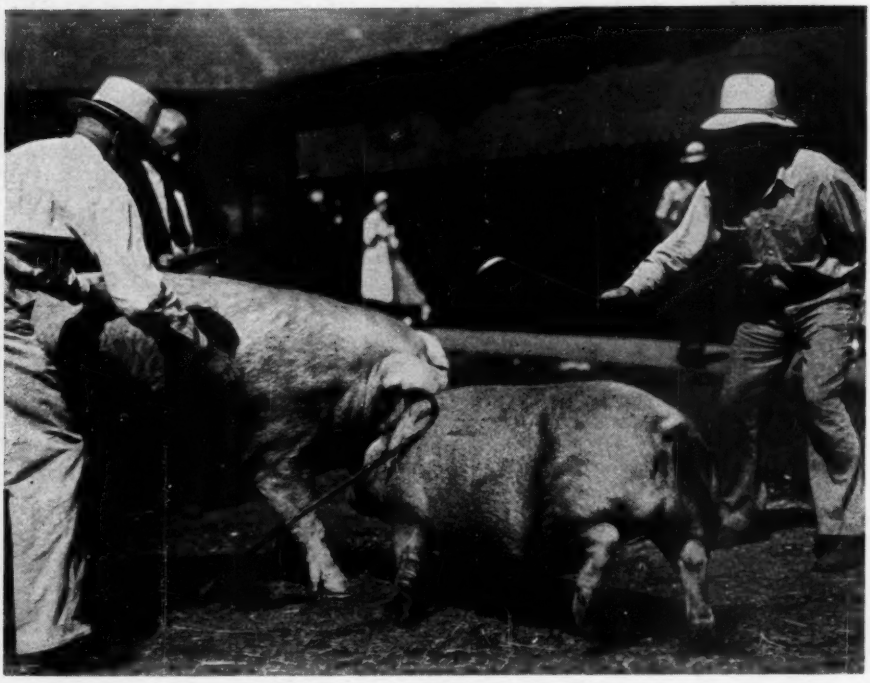
PICTORIAL

WHEN A MAN'S A MAN



Above: Fall work is forgotten when "they are coming round the bend."

Below: Two prize-winners contest the judges' decision "out of court."



Above: Indian summer days rearrange and repaint rural landscapes.

Below: There are many days of unemployment for doctors represented here.

Left: The gold in "them thar hills" tempts a Halloween jokester.

Below: Where one might expect to see a full range of autumn coloring.

The Editors Talk

"As the Soil Goes, So Goes the Town"

There is a great deal more to this saying than the fun of saying it. Using it as a title for an editorial in a recent issue of *Farm and Ranch,* the editor has well pointed out the wide-spread significance of the "jingle."

"The large cities of the country, especially those in agricultural areas," he says, "must quickly awaken to the fact that their interests are not local if they are to continue to prosper. When the soil in the small town and small city trade area washes away, or becomes unproductive for any other reason, that town immediately feels the loss. Continued decline in the amount of wealth produced is reflected in the loss of business and a decline in population. Once prosperous towns quickly go to seed. When business in the small towns and cities slips, business in the larger cities can be maintained only through the widening of their trade territory, and there is a limit to that form of expansion. Therefore, it behooves the large cities to take an active interest in the development of industry in the towns and cities in their trade territory, and in the conservation of their natural resources."

The editor points out that in full realization of these principles, the Kessler Plan Association of Dallas, originally organized for the purpose of developing the city along logical lines, has extended its activities and is striving to create an interest among the citizens of Dallas in the welfare of the towns and cities in the surrounding sixty or more counties. The secretary of the Association has called attention to the fact that the census figures show that every one of these counties, except Dallas and Tarrant and the counties in which there are oil activities, have lost population, and that the county-seat cities, as well as other cities in these counties, have either slowed down or are just about holding their own, or have fewer citizens than they had ten and twenty years ago.

A survey of the situation showed that the trade territory of these towns has slipped in production; that the soils have become unproductive; that the original owners have moved away, and many of the farms are occupied by tenants who are not encouraged to conserve and build up the land. Some of the towns apparently have gone to seed due to the lack of civic pride and constructive plans of development. This has resulted in the migration of young men and women and many of the more enterprising citizens.

We need, on the part of urban people, a greater realization of the importance and problems of soil productivity. Farm advisers, so frequently called upon to address urban groups, could well afford to make it a theme and stress the personal interest of their audiences in the welfare of their farm neighbors.

As the Texan editor points out, "Chambers of commerce frequently seek the location of industry, and at this time there is considerable discussion on the subject of decentralization of industry. One of the prime considerations of industry, in seeking a new location, is the desirability of the town or city as a place to live. Oftentimes it proves to be the controlling factor in making a choice. Therefore, chambers of commerce should strive to develop their city in such a manner as to make it attractive as a place to live; and furthermore, they will find it profitable to lend their aid in the conservation of the natural resources of their trade territory. In this the large cities should give constructive cooperation, for as the farms give support to the small cities, the small cities support the larger ones."

Pasture Progress

When the ills of a crop cause a consultation of specialists, that crop is on its way to health and vigor. Such a consultation was held on pastures in New York City late in September when, at a Pasture and Hayland Conference, members of the agricultural press, the fertilizer industry, and state and Federal agricultural scientists met in the best interests of the crop.

The conference was called by the National Fertilizer Association, and there were in attendance 20 editors and representatives of farm journals, 26 agricultural workers, and 84 representatives of the fertilizer industry. The purpose of the conference was to provide an intelligent approach to pasture and hayland problems and develop cooperation among all interested agencies in providing farmers with the most practical information and materials for improving these forage crops.

Many important papers were given and were followed by discussions involving the practical angles of the points brought out. General agreement emphasized a few general facts:

1. Cheap roughage, including hay, pasture, and silage, is necessary in order to make money from the production of milk or meat.

2. Pasture is the cheapest of all feeds.

3. The production of good pasture requires liberal applications of plant food.

4. All of the speakers agreed that it is profitable to fertilize hay and pasture land, although there was, of course, some difference of opinion as to the kind of fertilizer to use. There was general agreement that lime, superphosphate, and potash should be the basis for any system of pasture improvement and that nitrogen is essential, but the manner in which it is most economically supplied varies with local conditions.

5. There was complete agreement as to the need for improving a very large acreage of pasture and hayland throughout the country, in the South and Midwest as well as in the Northeast.

Such meetings are to be highly commended. The betterment of American agriculture was sincerely at heart, and the "common ground" provided a means to formulate policies on how best to serve in its furtherance.

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture and the State Experiment Stations relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

Research Bulletin 197, Iowa Agricultural Experiment Station, entitled "The Effects of Liming on the Liberation of Potassium in Some Iowa Soils," by Hartzell C. Dean, contains many outstanding conclusions following an extensive study of a number of Iowa soils. Analyses of 12 high-lime soils disclosed that all of the soils contained relatively large amounts of total potassium, carbonates, and total nitrogen. The investigation showed, however, that 11 of the 12 high-lime soils contained an insufficient amount of available potassium conducive to maximum plant growth, and that these soils were either in need of or would respond to potash fertilization. The author asserts that this low content of available potassium is correlated with the high carbonate content. It is also stated that soils containing 20 per cent or more of carbonate were deficient in available potassium, regardless of the total potassium they contained. Data obtained from these investigations indicate the depressive effect of calcium on the availability of potassium in soils may be partly due to the action of microorganisms. The results of this study concerning the replacement of potassium in the exchange complex by calcium confirm the findings of other investigators.

"Fertilizing Onions on Muck Soils" is the title of Cornell University Agricultural Experiment Station Bulletin 650 by J. E. Knott. A concise interpretation of the results secured from onion fertilizer experiments conducted for five years on muck soils of New York is interestingly discussed. Soils that had been cultivated for 3 years, 20 years, 30 years, and 56 years were employed in the experiments reported in this bulletin, these soils having been used to determine the optimum application of nitrogen, phosphoric acid, and potash for onions on muck soils differing in length of time they had been cropped. As a result of this work the author recommends certain fertilizer practices that should serve as a starting point from which a grower may adjust the quantity and the analysis to fit his particular conditions. Onions grown on recently cleared mucks should receive a ton of 0-10-10, or one-half ton of 0-20-20 fertilizer per acre. Some new mucks which support reeds and sedges instead of timber require nitrogen, for which 200 pounds nitrate of soda per acre are advised as a supplement to the 0-10-10 or 0-20-20 application, or 1,000 pounds of a 3-12-18 per acre may be used. A muck soil that has been fertilized well for 10 years or more and has not been flooded should have about 50 pounds of nitrogen and 80 pounds each of phosphoric acid and potash applied broadcast to meet the needs of the crop and maintain the reserve in the soil, or an application of from 1,000 to 1,200 pounds of a 5-8-7 per acre should be sufficient. It is best to use from 1,200 to 1,500 pounds of a 4-8-12 analysis for a few years on mucks that have been flooded to replace the fertility which may have been lost, the author suggests. It is also recommended that an application of 300 pounds of finely ground copper sulphate per acre should

be applied to mucks that produce onions with thin, poorly colored scales, and on which the tops die prematurely.

"The Effect of Soil Treatment on the Mineral Composition of Exuded Maize Sap at Different Stages of Development," Agr. Exp. Sta., Experiment, Ga., Bul. 193, May 1936, M. W. Lowry, W. C. Huggins, and L. A. Forrest.

"Recommendations Made by the Louisiana Agricultural Experiment Station for the Fertilization of Field and Truck Crops in Louisiana," Agr. Exp. Sta., Baton Rouge, La., C. T. Dowell, Director.

"Synthetic Manure Production in Michigan," Agr. Exp. Sta., East Lansing, Mich., Cir. Bul. 157, July 1936, L. M. Turk.

"A Review of the Experimental Work with Phosphate in Montana, 1928-1935," Agr. Exp. Sta., Bozeman, Mont., Cir. 148, Apr. 1936, Jesse R. Green.

"Recommendations with Reference to the Fertilization of Flue-cured, Sun-cured, and Shipping Tobacco Grown on Average Soils in Virginia, North Carolina, South Carolina, and Georgia for the Year 1937," Agr. Exp. Sta., Raleigh, N. C.

"Magnesium Deficiency. I. The Value of Magnesium Compounds in Vegetable Production in Virginia," Truck Exp. Sta., Norfolk, Va., Bul. 89, Oct. 1, 1935, R. L. Carolus and B. E. Brown.

"The Influence of Acid-neutral Fertilizers on Vegetable Crop Production in Eastern Virginia," Truck Exp. Sta., Norfolk, Va., Bul. 90, Jan. 1, 1936, Jackson B. Hester and Florence A. Shelton.

Soils

The earnest endeavor of our soil scientists to conserve the resources of the soil is evidenced by the excellent contributions which are appearing on this subject. Recent publications detailing valuable accomplishments rendered since cooperative agricultural agencies far and wide declared soil erosion a serious menace to all society include:

"Soil Erosion in Iowa," Special Report No. 2 of the Iowa Agricultural Experiment Station, by R. H. Walker and P. E. Brown, which reveals among other outstanding facts that about 30 billion tons of soil have been washed away from Iowa land since its cultivation was begun by man, representing a tremendous loss of plant nutrients valued at approximately $2,975 per acre of farm land.

"Cropping Systems in Relation to Erosion Control," Missouri Agricultural Experiment Station Bulletin 366, by M. F. Miller, which presents many significant recommendations in accord with the proper adjustment of cropping practices to control erosion.

"Soil and Rainfall Conservation in New Mexico," Bulletin 238 of the New Mexico Agricultural Experiment Station, by C. P. Wilson, P. E. Neale, K. W. Parker, and H. N. Watenpaugh. These authors portray the difficulties encountered in New Mexico in solving the problem of soil and rainfall conservation. Many striking illustrations depicting the results of improper range management, thus inviting soil blowing, gully forming and flood producing effects, are shown.

"A Soil Resources Program for Oklahoma," Circular 335 of General Series 106, issued by the Oklahoma Agricultural Extension division, outlines the work that needs to be done to show an improved "inventory" of Oklahoma's soil resources. "Protect, improve, and Prosper with the Soil" is the general theme of this progressive program. "Lost soil fertility is not the whole story in parts of Oklahoma. Some of the state's soils, in fact, never had abundant amounts of certain minerals necessary to produce crops most profitably. But those minerals can be put into the soil, and they can be restored where they have been lost by washing or used up by cropping." The circular declares that "a farmer is no richer than his soil."

"The Reaction of Zinc Sulfate with the Soil," Agr. Exp. Sta. Gainesville, Fla., Bul. 298, June 1936, H. W. Jones, O. E. Gall, and R. M. Barnette.

"Some Bacteriological and Chemical Effects of Calcium and Magnesium Limestones on Certain Acid Iowa Soils," Agr. Exp. Sta., Ames, Iowa, Res. Bul. 196, Apr. 1936, Harold L. Dean and R. H. Walker.

"Liming the Soil," Univ. of Ky., Ext. Div., Lexington, Ky., Cir. 59 (5th Ed., Rev.), Feb. 1936, P. E. Karraker.

"Soil Testing, A Practical System of Soil Diagnosis," Agr. Exp. Sta., East Lansing, Mich., Tech. Bul. 132 (Rev.), Oct. 1935, C. H. Spurway.

"Testing Soils for Acidity by the Modified Comber Method," Agr. Ext. Serv., Columbia, Mo., Cir. 339, *Mar.* 1936, *M. F. Miller.*

"Report on the Investigation of Phosphorus-deficient Soils, 1935," *Agr. Exp. Sta., Bozeman, Mont., Bul.* 316, *Mar.* 1936, *Jesse R. Green and F. M. Harrington.*

"Genesis and Composition of Peat Deposits," Cornell Univ., Agr. Exp. Sta., Ithaca, N. Y., Memoir 188, *Apr.* 1936, *B. D. Wilson, A. J. Eames, and E. V. Staker.*

"Soil Survey of Livingston Parish, Louisiana," U. S. D. A., Washington, D. C., Series 1931, *No.* 22, *A. C. Anderson, E. B. Deeter, S. Rankin Bacon, W. H. Buckhannan, C. S. Simmons, K. V. Goodman, R. R. Finley, and B. H. Hendrickson.*

"Soil Survey of Oscoda County, Michigan," U. S. D. A., Washington, D. C., Series 1931, *No.* 20, *J. O. Veatch, L. R. Schoenmann, C. E. Millar, and A. E. Shearin.*

"Soil Survey of Hubbard County, Minnesota," U. S. D. A., Washington, D. C., Series 1930, *No.* 38, *P. R. McMiller, C. S. Simmons, G. A. Swenson, and W. J. Leighty.*

"Soil Survey of Dillon County, South Carolina," U. S. D. A., Washington, D. C., Series 1931, *No.* 17, *W. J. Geib, W. J. Latimer, F. R. Lesh, and A. E. Shearin.*

Crops

E. H. Rawl is stressing the important considerations applicable to potato growers in South Carolina in establishing the production of this crop as a profitable enterprise. In South Carolina Agricultural Extension Service Circular 152, entitled "Sweet Potato Production," he gives specific information on such matters of production as selecting the best varieties, proper seed and treatment, growing plants and vines, soil types best suited, recommended fertilizers, and cultural practices. When plantings are made for the northern markets, the author states that the Porto Rico variety consisting of the copper-colored strain should be grown exclusively. Much care should be exercised in handling seed freed from all dirt; and all that show black spots, rotten ends, and bad bruises should be discarded. Seed potatoes to be treated for disease-producing organisms should be held for at least 8 and not more than 10 minutes in a solution of mercuric chloride. To produce sweet potatoes of the finest quality, the publication suggests that sandy loam soils are desirable, since stiff clays and the deep sands are poorly adapted. Based on experimental work and repeated demonstrations in South Carolina a fertilizer carrying 3 per cent ammonia, 8 per cent phosphoric acid, and 8 to 10 per cent potash, applied at the rate of 800 to 1,000 pounds per acre, is recommended for sweet potatoes in that state. A very helpful table showing suggested materials to use in mixing a fertilizer analyzing 3-8-10 (N-P-K) suitable for average soils is given.

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"Pasture Investigations, Eighth Report, Modifying the Seasonal Growth Habits of Grasses," Agr. Exp. Sta., Storrs, Conn., Bul. 209, *Mar.* 1936, *B. A. Brown and R. I. Munsell.*

"1935 *Report Cooperative Extension Work in Agriculture and Home Economics," Agr. Ext. Serv., Gainesville, Fla., Wilmon Newell, Director.*

"Pastures for Georgia," Agr. Ext. Serv., Athens, Ga., Bul. 457, *Feb.* 1936, *E. D. Alexander.*

"The Tung-oil Tree in Georgia," Agr. Exp. Sta., Experiment, Ga., Cir. 108, *Apr.* 1936, *H. L. Cochran.*

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"Science Aids Idaho Farmers—Annual Report for the Year Ending December 31, 1935," *Agr. Exp. Sta., Moscow, Idaho, Bul.* 220, *June* 1936, *E. J. Iddings, Director.*

"Strawberry Culture in Illinois," Agr. Exp. Sta. and Ext. Serv., Urbana, Ill., Cir. 453, *May* 1936, *A. S. Colby.*

"Grape Culture," Agr. Ext. Serv., Lafayette, Ind., Ext. Bul. 102 (3*rd Rev. Ed.*), *Apr.* 1936, *Rev. by C. E. Baker.*

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"Cotton Growing for 4-H Club Members," Agr. Ext. Serv., Baton Rouge, La., Ext. Cir. 160, *Mar.* 1936, *R. A. Wasson.*

"Ramie, A Critical Survey of Facts Concerning the Fiber Bearing Plant, 'Urtica Nivea'," Univ. Studies No. 26, *La. State Univ. Press, Baton Rouge, La., G. L. Carter and Paul M. Horton.*

"The Relation of Physical Properties and Chemical Composition of Red Clover Plants to Winterhardiness," Agr. Exp. Sta., College Park, Md., Bul. 391, *Jan.* 1936, *Glenn A. Greathouse and Neil W. Stuart.*

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in Massachusetts," Agr. Exp. Sta., Amherst, Mass., Bul. 330, Apr. 1936, Frank A. Waugh.

"The Katahdin Potato in Michigan," Agr. Exp. Sta., East Lansing, Mich., Sp. Bul. 271, June 1936, H. C. Moore and E. J. Wheeler.

"The Production of Cucumbers for Pickling Purposes," Agr. Exp. Sta., East Lansing, Mich., Sp. Bul. 273, July 1936, H. L. Seaton, Ray Hutson, and J. H. Muncie.

"Factors Influencing the Yields of Montmorency Cherry Orchards in Michigan," Agr. Exp. Sta., East Lansing, Mich., Sp. Bul. 275, July 1936, V. R. Gardner.

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"Management of Bent Grass Lawns," Agr. Exp. Sta., East Lansing, Mich., Cir. Bul. 156, May 1936, James Tyson.

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"Bush Fruit Growing in Minnesota," Agr. Ext. Div., Univ. of Minn., University Farm, St. Paul, Minn., Sp. Bul. 79, Rev. Mar. 1936, Franc P. Daniels.

"Forty-second Annual Report. July 1, 1934 to June 30, 1935," Agr. Exp. Sta., University Farm, St. Paul, Minn., W. C. Coffey, Director.

"Influence of Length of Day (Photoperiod) on Development of the Soybean Plant, var. Biloxi," Agr. Exp. Sta., Columbia, Mo., Res. Bul. 242, July 1936, A. E. Murneek and E. T. Gomez.

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"Reshaping Montana's Agriculture—Forty-first Annual Report. July 1, 1933 to June 30, 1934," Agr. Exp. Sta., Bozeman, Mont., F. B. Linfield, Director.

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"Meadow Improvement through Seeding, Fertilization and Management," Cornell Univ., Agr. Ext. Serv., Ithaca, N. Y., Bul. 181, June 1929 (Rev. Mar. 1936), A. F. Gustafson.

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"Effects of Some Environmental Factors on Growth and Color of Carrots," Cornell Univ., Agr. Exp. Sta., Ithaca, N. Y., Memoir 186, Mar. 1936, W. C. Barnes.

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"Tensile Strength, Extensibility, and Other Characteristics of Wheat Roots in Relation to Winter Injury," Agr. Exp. Sta., Wooster, Ohio, Bul. 568, May 1936, C. A. Lamb.

"Experiments with Potatoes on Muck Soil," Agr. Exp. Sta., Wooster, Ohio, Bul. 570, June 1936, John Bushnell.

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"Potato Culture in Pennsylvania," Agr. Ext. Serv., State College, Pa., Cir. 167, Mar. 1936, J. B. R. Dickey.

"Annual Report for the Fiscal Year Ending June 30, 1935," Agr. Exp. Sta., Brookings, S. Dak., James W. Wilson, Director.

"All-year Pasturing with and without Concentrates for Dairy Cattle," Agr. Exp. Sta., Knoxville, Tenn., Cir. 58, Apr. 1936, Ben P. Hazelwood.

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"Twenty-first Annual Report of Cooperative Extension Work in Agriculture and Home Economics, State of Vermont, for Year 1935," Agr. Ext. Serv., Burlington, Vt., J. E. Carrigan, Director.

"Further Studies of the Limits of Photosynthesis," Agr. Exp. Sta., Burlington, Vt., Bul. 402, Mar. 1936, G. Richard Burns.

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"Today's Science for Tomorrow's Farming—Annual Report of the Director 1934-35," Agr. Exp. Sta., Madison, Wis., Bul. 435, Mar. 1936, Chris L. Christensen, Director.

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"Celery Growing," U. S. D. A., Washing-

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Economics

In a recent bulletin by K. T. Wright of the Farm Management Department, Michigan State College, entitled "Economics of Bean Production in Michigan," are presented some very interesting practical facts based on the experiences of practical farmers with problems of bean production in that state. Pea beans are one of the major cash crops of the Michigan farmer, and Michigan is the leading state in bean production. Due to the fact that the pea bean is by far the most important grown in the state, the results of the study are more applicable to this type of bean crop. Bean production has increased much faster than population. In the five years from 1930-1934 there were 40% more pea beans produced per capita than in 1890.

Unfortunately, the study was made during a period when bean prices were extremely low, and the weather conditions during the critical months for this crop averaged below normal. Thus the results of the study must be interpreted in light of these facts. The wide variation in yields for the different years indicate the wide variation in weather conditions. The highest yields obtained by any of the cooperators in 1929-30 were 25 bushels; in 1931, 34 bushels; in 1932 (when the rainfall was adequate) 42 bushels. The lowest yields average around five bushels.

It was found that yields were an important factor in profitable bean production. The low yield group, taking the state as a whole, lost $7.12 per acre on their bean crop, while the high yield group made a profit of $7.47 on their crop. As the yield went up, the cost per bushel went down. It was found that in general the growers obtaining the higher yields, grew the robust variety, plowed the ground in the spring, planted their beans comparatively early, planted them on well-drained land, efficiently utilized their barnyard manure and used more commercial fertilizer than those receiving the lower yields.

The records were analyzed on the basis of soil types, and it was found that the growers on Brookston soil had lower than the average charges for labor, power, and machinery, but the land charges were high making the total cost per acre $29.92. The yield for this group averaged 15.2 bushels per acre with an average cost of $3.19 a hundred, and the return per hour of labor averaged 29c. On the Miami soils the acre cost was $27.60, due to the lower charges for the land, but the average yield was only 10.4 bushels making the beans cost $4.25 per hundred, and the labor returns were only 9 cents an hour. On the sandy soils records were available for only three years, and the results are not fairly comparable. The cost per acre averaged about the same as on the Brookston soils. The yield per acre was only 7.2 bushels and the cost per 100 lbs. of beans was twice as much as on the Brookston soils. These farmers lost 9 cents an hour for the time they spent on their crop.

It is concluded that on the basis of present production and demand the possibility of profit in beans in the near future, when the yields are only about 10.7 bushels per acre, is very limited. However, the growers using good practices and efficient methods of production resulting in good yields can reasonably hope for a fair return for their management and labor.

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"Tonnage of Fertilizers Reported by Manufacturers as Shipped to Kansas," 1934 and 1935, State Bd. of Agr., Topeka, Kans., C. E. Buchanan, Dir. of Control Div.

"Public Produce Markets of Michigan," Agr. Exp. Sta., East Lansing, Mich., Sp. Bul. 268, May 1936, Orion Ulrey.

"Changes in Standards of Consumption During a Depression," Agr. Exp. Sta., East Lansing, Mich., Sp. Bul. 274, July 1936, Irma H. Gross and Julia Pond.

"Readjusting Montana's Agriculture. VII. Montana's Dry-land Agriculture," Agr. Exp. Sta., Bozeman, Mont., Bul. 318, Apr. 1936, E. A. Starch.

"Readjusting Montana's Agriculture. VIII. Tax Delinquency and Mortgage Foreclosures," Agr. Exp. Sta., Bozeman, Mont., Bul. 319, May 1936, Roland R. Renne.

"An Analysis of the Present Status of Agriculture on the Sun River Irrigation Projects," Agr. Exp. Sta., Bozeman, Mont., Bul. 321, May 1936, P. L. Slagsvold.

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"Development and Use of Standards for Grade, Color, and Character of American Cotton Linters," U. S. D. A., Washington, D. C., Misc. Pub. 242, May 1936, Guy S. Meloy.

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Winter Corn and Cotton

Corn and cotton are hot-weather crops. A farmer, even in the South, cannot grow these crops in winter. But he can grow what is substantially the equivalent of corn or cotton as a winter crop, says the United States Department of Agriculture. A. D. McNair, of the Bureau of Agricultural Economics, and Roland McKee, of the Bureau of Plant Industry, tell how.

Plant a legume crop that will grow in fall and winter and plow it under in the spring. Then plant corn or cotton and the field will yield enough more grain or lint to make the equivalent of a winter cash crop. In farm management studies on farms in Georgia, Alabama, and the Carolinas, these men found that, on the average, corn which followed a winter legume in the South yielded 14 bushels an acre more than corn on similar land that stood bare. So the 14 bushels an acre could be regarded as the corn yield of the winter legume.

Cotton following a winter legume yielded on the average about 100 pounds more of lint than cotton on fallow fields. This 100 pounds is traceable to the legume. The farmer who plants legumes has other advantages. The winter legumes prevent erosion, improve the soil, make cultivation easier, and furnish some winter feed for livestock.

Well-fed Raspberries Stand Cold

Winter hardiness of some of the berries, particularly raspberries, is not entirely a matter of winter temperatures or snow cover, as many have supposed. It is the well-fed raspberry plant that endures cold winter weather. When the summer climate is favorable to development of anthracnose (gray bark) and leaf spot, the plants are defoliated and go into the winter weakened and with scant reserves of food, says George M. Darrow of the Bureau of Plant Industry. The result is winter injury. In Maryland, for example, where winter temperatures are relatively mild because it is near the southern border of the raspberry range, there has been much winter-killing among varieties that are known to be hardy even in Canada. To prevent winter injury, growers need to spray regularly in the summer for control of fungus diseases.

Mr. Nat Stafford Learns About Potash

(*From page* 17)

facts we were walking about in that corn field. Where the phosphate-potash mixture was used, the corn was beautiful. It had matured good ears on good stalks and would produce a profitable crop. Where he ran out of the mixture and had used only the phosphate, the corn had made practically no growth, had fallen ove. badly, and one could hardly find a decent ear in the whole area. But there was an island of good corn in this area, and that was where he had thrown the 10 quarts of muriate on the day he had run out of a job. At the end of the field where the manure had been added to the phosphate, the corn again was good, but not quite in the condition found where the phosphate-potash mixture had been used.

The island of good corn that got the 10 or 12 qts. of muriate of potash one day as a top-dresser. This was in the center of the area of poor corn and at the edge of the 25-acre field.

Mr. Stafford was so concerned over his unwitting demonstration that he went to Graham and urged County Agent Shiver to come out and see the field. Others have made similar trips. To them Mr. Stafford tells the story of what happened and how it happened. He voices no explanation except that the soil is the same throughout the field save for one narrow strip where an old hedgerow runs across it. He knows now that it would have paid him to have mixed potash with his phosphate in spite of his great hurry to get his corn seed in the ground. But it was dry in North Carolina this spring, and for a while it looked as if few of us would make any corn at all. Perhaps he is to be excused, therefore, for his haste to take advantage of the blessed moisture. Certainly he has gained in knowledge what he lost in corn yield.

Potassium Availability in Illinois Soils

(*From page* 15)

prevent replenishment of potash from the minerals. The plant, over a period of time, can overcome or at least not be affected significantly by factors which might at first hand be considered theoretically important; however, we did find that the soil test for replaceable potassium was affected by certain of these factors. We found that we had to have a very strong replacing solution under the soil-test conditions where only one equilibrium is established between soil and solution. As we reduced the replacing strength of the solution it took out less and less replaceable potassium, and this reduction in amount was not in proportion to the total amount present but was influenced mainly by the amount of replaceable calcium and magnesium present. With more dilute solutions, therefore, we obtained values having no relation to the total amount present; i. e., the amount of available potassium.

This work convinced us that it is not practical to try to measure the relative "availability" of the replaceable potassium by a chemical test, and that our best bet is to measure the total replaceable potassium present and let the crop establish the availability in terms of its own requirement; i. e., establish the level required. If the replacing solution is too weak to replace all the potassium in the lower testing soils and a large part of the replaceable potassium in the higher testing soils, even relative results are not possible.

In the above discussion I have not included some important exceptions to our general findings. It is only on the silt and clay loam soils that our general calibration is of value. Two fields on dune sand did not test high in potash and yet gave no decided responses. These sandy soils are very open and contain only a small amount of organic matter and clay. The base-exchange capacity is less than 3 M.E., or less than one-tenth that of the better soils. All of these factors help to make for a higher positional availability than on the silt and clay loams. We have no calibration of the test for these sandy soils. We know that a "high" test indicates sufficient potash, but we do not know at what point crop response occurs, because we do not have sufficient field experiments to effect a calibration. Fortunately, we have only a limited area of sand in our state. If it were an important type we could establish the necessary calibration by field and laboratory work.

The changes in the replaceable po-

tassium level during the season and from year to year are interesting to watch, as are the changes in the distribution throughout the soil profile. These changes do not affect the potassium fertility of the soil until the level falls below the level required for best results. Some soils can maintain a luxury level; our Hartsburg and Minonk experiment fields are examples, with well over 200 pounds of replaceable potassium present. The Dixon field level has been steadily going down since 1929, and we expect all plots to respond to potash application in time. The chart accompanying this article (Figure 1) shows what happens when the replaceable potassium level is reduced seriously by cropping. This chart shows that over a period of only five years the Dixon field has been converted from a non-responsive to a potash responsive field, and the decrease in the replaceable potassium values reveals the reason for this. On the other hand, even soils which have never been farmed in southern Illinois are already low in replaceable potassium, since these soils have a naturally low rate of supply. The use of sufficient potash will maintain a good level of replaceable potassium, and the level in the subsurface will also be raised eventually, provided the amounts of potash fertilizer used exceed the amounts removed by the crops grown. On the other hand, in untreated, deficient soils the subsurface potash level is lower than that of the surface.

Alkali spots caused by snail shell accumulations under wet conditions are usually deficient in replaceable potassium, due to the weathering away of the mica form of potash which occurs in the very fine portion of the soil mass. The fact that the calcium bicarbonate formed from the snail shells acts as a replacing agent also helps to prevent the building up of a good level of replaceable potassium.

In general, our potassium deficiencies are related to the amount of the mica form of potassium and vary progressively with the change in the amount of this potassium mineral present in our loess soils. As a result of this regular variation we have been able to divide the state into areas corresponding to the relative rate of supply from the mineral forms. We are thus able to show the areas deficient in potash, the areas which will soon become deficient, and the areas where potassium deficiencies will not generally occur in the near future, although a few deficiencies have shown up in local areas. This map is shown in Figure 2.

Measure of Supply

One important question which has not been answered is how long the best soils will be able to continue to supply available potash in sufficient amounts. The Dixon field on one of our best soil types is already responsive to potash, although it can still produce on the RLP plot without added potash much higher crop yields than the county average. It is highly probable that the decrease in yield on the RLP plot resulting from this deficiency will slowly develop over quite a number of years, but that crop yields will not become as low as on our southern soils, during our lifetime at least. We have tried to measure this rate of supply of available potassium from the non-available form in the laboratory by acid digestion methods. Although we can get good relative results, they cannot be translated into terms of years.

In the above discussion I may have used the terms "low in available or replaceable potassium" and "deficient in potash" synonymously. As a matter of fact, a distinction should really be made between the two terms. We consider a soil low in replaceable (available) potassium when it contains less than 90 pounds per acre in 2,000,000 pounds of soil. We call this low because the common field

crops of Illinois will respond to potash fertilization in a profitable way if not limited by other factors. We know, however, that the crop will not have a chance to respond satisfactorily if other "deficiencies" are not made up. In southern Illinois in particular we recognize two conditions. The soil containing less than 90 pounds per acre we call "low in available potassium" when other elements are still "deficient." If these other deficiencies have been made up, thus giving the plant a chance when potassium is added, we then call it a potash deficient soil. Most of the limed, phosphated, and legumed fields in central southern Illinois are "potash deficient," while most of the untreated soils are "low in available potassium," although "potentially deficient" under good treatment.

Proper Management

The 103 plot at the Dixon field which tested medium in potassium (113 pounds by the quantitative laboratory method) in 1931, would not be recognized as a deficient soil if farmed without the necessary soil treatment. It is only by increasing the productive capacity of a soil to a point where it can utilize more potash than is being supplied that a soil becomes truly potash deficient. I believe that most of the farmers on our best soils in northern Illinois are farming at too low a productive level to efficiently utilize all the potash becoming available. It is only through the use of a good system of soil management and treatment that productive levels which will effectively utilize the potash are reached. If the potential productive capacity is sufficiently higher, then purchased potash can be used at a profit. We hope that most of our better soils will be able to give their high yields under good treatment for a long time without having to supply potash fertilizer. This will probably be true of some of the best soils. However, even though potassium deficiencies develop, due to increased crop yields, the cause of the development must be kept in mind.

Any system which can raise the productive level of a soil from 35-40 bushels of corn (county average) to 63 bushels (RLP treatment, average of 11 northern fields) can well afford to include potash in the treatment when and if this becomes necessary to maintain the high level of productivity reached. Just as we undertake trying to do something too much for us to accomplish and finally realize our own personal deficiencies, so many of our soils will probably be shown to be not as potassium rich as we have considered them when we actually put them to the test. Thus it is that with our northern Illinois soils so high in potential productivity, any fertility treatments designed to actually attain their high potential capacity will probably eventually have to include potassium. We consider it far better to treat our soils in this manner, maintaining a good rotation, keeping the ground covered most of the time, and turning under large amounts of residue and green manures, than to run down the fertility and productiveness of our soils by a corn and oats rotation, thus exposing them to erosion.

In southern Illinois our lime, legume, and phosphate treatment system will work only up to the point where the yearly supply of available potassium is being effectively used for the rotation as a whole. This, however, is at a low productive level as compared with the full possibilities, for higher returns are obtained when potash is added to the fertilizer system. From the practical standpoint, however, credit must be given to the whole treatment, since all elements of the treatment are necessary to produce the effect. On our most deficient fields the competition between the crops in the rotation is at a maximum on the RLP plot, and corn, having the highest requirement, suffers the most.

At present we are trying to overcome the old viewpoint that a good soil treatment system including residues and green manures can practically bring about the liberation of the mineral potash and build up the available supply. We have many farmers in southern Illinois who have used lime, legumes, and phosphate, but do not yet understand that potash in addition is essential in order to get their money back from the lime and phosphate treatment. They do not know that these treated fields are potentially their richest fields. We are going to make it our business to let them know it and have already started with various news releases. Furthermore, we are going to tell the same story over and over, that is, that these soils are low in available potash, that they can never hope to liberate potash from the minerals at anywhere near a sufficient rate, and that potash must be returned to the land if they intend to attain the productive level possible.

Flower Symptoms Warn of Food Deficiency

(*From page* 10)

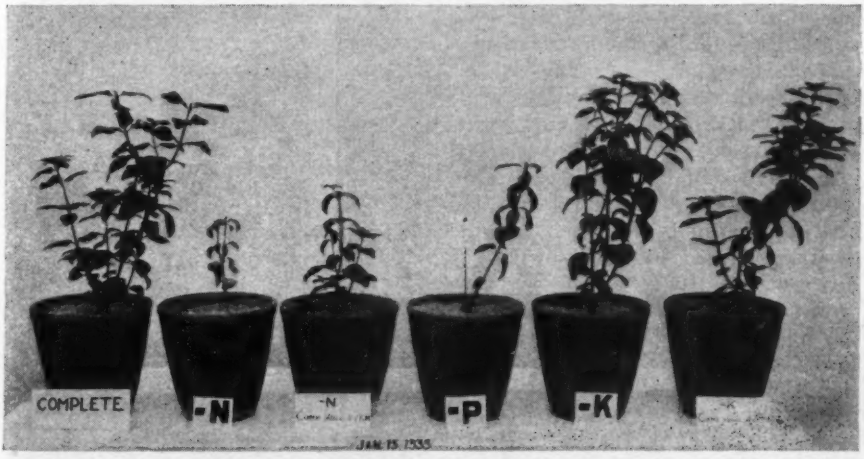
The young leaves were of a very dark-green color. The old leaves were bronzy-dark green in color and showed a definitely purple cast beneath, later shriveling and dying to a purplish-bronze color.

Without Potash—The plants were only slightly stunted in growth. The young leaves were yellowish green in color with dark-green veins and a reddish tinge along the margin. The older leaves turned purplish green in color on the upper surface but not purplish beneath like those in the treatment without phosphorus. These leaves began to die first along the margin and in spots over the entire leaf.

Sweet Pea

Complete—The plants were vigorous in growth and of a normal green color.

Without Nitrogen—The plants were very stunted in growth, and all of the leaves were very light yellow, almost white, in color. The old leaves died and dried to a grayish-white, papery color and remained on the plant quite a while before dropping.



Snapdragon. Nos. 3 and 6 show recovery from acute —N and —K deficiency 6 weeks after these plant foods were supplied.

Without Phosphorus— There was not a distinct symptom that could be attributed to a phosphorus deficiency in this treatment. The plants were almost normal in growth, showed only a slight yellowing of the old leaves, and no shedding of the leaves.

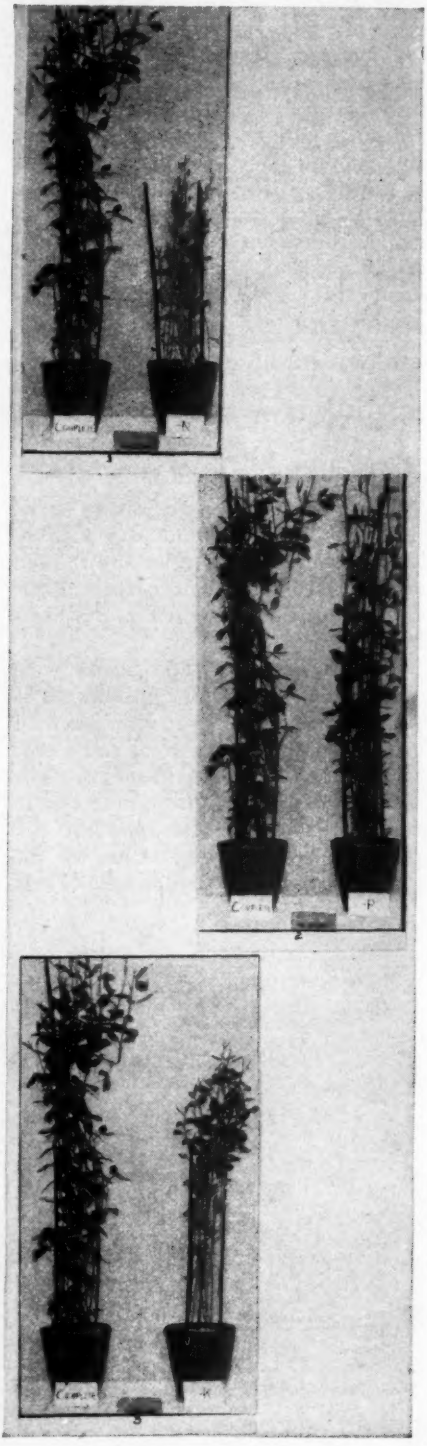
Without Potash—The plants were stunted in growth, and the older leaves showed a progressive yellowing from the margins to the center of the leaf. The veins of the yellowing leaves remained green until the entire leaf had turned yellow. The yellowing progressed upward until only the young leaves at the tip remained green. The dead leaves dropped from the plant early.

Several tests were run to determine whether plants showing symptoms of acute nutrient deficiencies would recover if the deficient nutrient was supplied.

Roses in the minus-nitrogen treatment that had ceased growing and had dropped all leaves produced new growth in 2 weeks after nitrate of soda was added to the nutrient solution.

Cinerarias without potash, showing whitish-yellow spots between the veins and whitish-yellow margins, regained their normal dark-green color, except for a very narrow yellow margin on the oldest leaves, in 6 weeks after potash was added to the nutrient solution.

The stunted and rusty-yellow Snapdragons that had ceased to grow without nitrogen, regained their normal green color and began to grow soon after nitrogen was added to the nutrient solution. Except for the dwarfing caused by the omission of nitrogen, the plants were as vigorous as those in the complete treatment. In the minus-potash treatment, the yellowish-green young leaves regained a normal green color in 6 weeks after potash was added to the nutrient solution. Even the oldest leaves, with the



Right: Nutrient deficiency symptoms exhibited by the Sweet Pea.

brown margins and spots over the entire leaf, regained a normal green color except for the brown areas.

Summary

In general, the visual deficiency symptoms for nitrogen (N), phosphorus (P), and potassium (K) for the plants studied may be summarized as follows:

1. **Nitrogen deficiency** produces a severe dwarfing of the plant and a uniform yellowing of all leaves. The young leaves begin to yellow very soon after the oldest leaves begin to turn. The affected leaves die slowly and remain attached to the plant for some time. The plant ceases to produce new growth soon after yellowing begins.

2. **Phosphorus deficiency** produces a severe dwarfing of the plant with most of the leaves remaining abnormally dark green. In severe cases, the oldest turn grayish-green or sometimes purplish-green and later begin to turn yellow. The yellowing usually begins at the margin and progresses toward the petiole, and the leaf usually drops before it becomes completely yellow. The plant ceases to produce new growth soon after yellowing begins.

3. **Potassium deficiency** usually produces only a slight dwarfing of the plant, and the leaves remain normal dark green in color until affected by the characteristic potassium deficiency injury. The injury usually appears first on the oldest leaves when the margin and area between the veins turn yellow and the veins remain green. Later the leaf begins to turn brown and dies along the margin and in spots over the leaf. The leaves die slowly and remain attached to the plant for some time after dying.

Potash for Cotton Wilt

(*From page* 22)

potash was relatively high but was much lower than on either of those which had had no potash. The October count showed merely a consistent increase in amount of wilt in all plats.

The average infection for the check and nitrate plats for the two years was 44.25% and 39.83%, respectively. The lowest wilt infection over the 2-year period was on the plat receiving 200 lbs. of nitrate of soda and 100 lbs. of muriate of potash, namely, 11.17%. This was a very material reduction over the infection on the check and nitrate plats. The highest yield also, 1,302 lbs. for the 2-year average, occurred on the same plat, as compared with 985 and 1,054 lbs. for the check and nitrate plats for the same period. The indications in this test, as in the one reported immediately preceding it, are that potash fertilizers, even when used in combination with other necessary elements, though beneficial in bringing about very marked reduction in wilt infection, cannot be depended upon to adequately control wilt if a very susceptible variety of cotton is used.

The same test was planted on the property of W. M. Simpson, Webb, Miss., in 1931 and 1932. The soil on which it was located was of quite a sandy character, entirely typical of the bulk of that characteristic of the Delta in general, which is of a much heavier and more alluvial nature. Such sandy spots are, however, not uncommon in certain parts of the Delta. The chief variation in the lay-out of the test consisted in the size of the plats. In this case they were only five rows wide instead of 10 as in the two tests previously reported. In 1931 the ground was prepared and the fertilizer weighed and applied by hand on March 22. Missdel No. 2 cotton was planted two weeks later. In 1932 the ground was pre-

pared, the fertilizer applied, and the seed planted on April 9.

In both years wilt counts were made in July, August, and early October, the final one being after harvest was completed. These counts, together with other results secured, are presented in table III. The table shows that wilt infection progressed at the various dates very much in the same manner as in the two tests previously reported. The 2-year average presents a very satisfactory picture of conditions for each of the inspection dates, with the relative position of each of the plats remaining approximately the same with respect to infection. Wilt was heaviest in each case on the check plat which received no fertilizer. The nitrate plat ranked next in infection, the respective average infection for the two plats over the 2-year period being 45.15 and 37.15%.

All plats receiving potash showed a very materially reduced wilt count. The lowest percentage of infection occurred on the plat treated with 200 lbs. of potash alone (Fig. 1) namely, 8.9%, while the plat receiving 100 lbs. of potash alone ranked second lowest with 11.75%. The plat receiving 200 lbs. of nitrate of soda and 100 lbs. of muriate of potash showed 12.4% wilt and was followed in order by the two receiving 200 lbs. of soda and 50 lbs. of potash and 50 lbs. of potash alone, with wilt percentages of 16.6 and 19.39%, respectively.

Yield records over the 2-year period indicated that the most efficient application of fertilizer among those tested, as shown by decrease in wilt and increase in yield, was a combination of 200 lbs. of nitrate of soda and 100 lbs. of muriate of potash per acre. This plat gave an average yield of 1,568 lbs. of seed cotton, an increase of 814 lbs., or 107.97% over the check plat. The one receiving 200 lbs. of soda and 50 lbs. of potash yielded 1,393 lbs., an increase of 639 lbs., or 84.75%. The

TABLE III. WILT FERTILIZER TEST. PROPERTY OF W. M. SIMPSON, WEBB, MISS., 1931-1932

Treatment	Pct. wilt infection 1931 July	1931 Aug.	1931 Oct.	1932 July	1932 Aug.	1932 Oct.
Check no fertilizer	7.2	28.7	41.3	7.8	33.1	49.0
Nitrate of soda—200 lbs	4.1	27.1	39.6	6.3	24.9	34.7
Nitrate of soda—200 lbs. and muriate of potash—100 lbs.	.8	6.7	12.0	1.2	7.9	12.8
Nitrate of soda—200 lbs. and muriate of potash—50 lbs.	2.2	10.0	16.2	2.4	10.8	17.0
Muriate of potash—50 lbs	3.4	14.1	20.5	3.5	13.0	18.2
Muriate of potash—100 lbs	2.1	8.4	13.0	2.2	7.0	10.5
Muriate of potash—200 lbs	1.1	5.8	9.0	2.0	6.3	8.8

TABLE III-a

Treatment	Pct. wilt infection 2-year-Av. July	2-year-Av. Aug.	2-year-Av. Oct.	Lbs. seed cotton per acre 1931	1932	2-year Av.	Av. Increase
Check no fertilizer	7.5	30.9	45.15	752	756	754	...
Nitrate of soda 200 lbs.	5.2	26.0	37.15	960	1,080	1,020	266
Nitrate of soda—200 lbs. and muriate of potash—100 lbs	1.0	7.3	12.40	1,588	1,548	1,568	814
Nitrate of soda—200 lbs. and muriate of potash—50 lbs	2.3	10.4	16.80	1,444	1,342	1,393	639
Muriate of potash—50 lbs	3.4	13.5	19.39	1,004	994	999	245
Muriate of potash—100 lbs	2.1	7.7	11.75	1,120	1,012	1,066	312
Muriate of potash—200 lbs	1.5	6.0	8.9	1,152	1,212	1,182	428

application of 200 lbs. of potash alone gave an average yield for the two years of 1,182 lbs., an increase of 428 lbs., 56.76%. This application was much more efficient in wilt control and much more profitable than was that of 200 lbs. of nitrate of soda alone, which was the fertilizer treatment that had been given to this plat of land by the grower in previous years. The average yield of the latter was 1,020 lbs., an increase of only 266 lbs. or 35.27% over the check. This was exceeded even by the plat treated with 100 lbs. of potash alone, which yielded 1,066 lbs., an increase of 312 lbs., or 41.37%. In 1931 the yield of the nitrate plat was exceeded even by the one receiving the meager application of 50 lbs. of potash alone.

This test indicated that on the type of soil represented and with the heavy infestation of wilt which occurred on it potash was more important and profitable on account of the degree of wilt control secured than was an equivalent amount of nitrate when the elements were applied separately. The most efficient fertilizer, however, was one which contained both elements combined in proper proportions and in adequate amounts.

In 1929 and 1930 another simple test was planned and conducted on the property of D. E. Denby, Charleston, Miss. This was on land at the eastern edge of the Delta, immediately adjacent to the bluffs which bound it at that point, very similar in character to that on which occurred the test on the property of Spencer J. Brown, Cascilla, Miss., which has been discussed previously. In fact, these two tests were but two or three miles distant from each other.

Three plats were laid out, the first being the check and receiving no fertilizer, the second receiving 100 lbs. per acre of nitrate of soda, which was the treatment that had been given the land in the past by this particular grower, and the third received the 100 lbs. of nitrate of soda and an additional 50 lbs. of muriate of potash per acre. All plats were replicated three times. They were planted with Delfos 6102 cotton, and wilt counts and yield records were taken at the end of the harvest season. The results are shown in table IV.

TABLE IV. WILT FERTILIZER TEST ON PROPERTY OF D. E. DENBY, CHARLESTON, MISS. 1929-30.

Treatment	% wilt infection			Lbs. seed cotton per acre			
	1929	1930	Ave.	1929	1930	Ave.	Ave. % increase
Check No fertilizer...	44.3	47.6	45.95	763	714	738.5	.....
Nitrate of soda—100 lbs.	47.0	50.2	48.60	911	935	923.0	23.49
Nitrate of soda—100 lbs. and muriate of potash—50 lbs.	15.0	17.3	16.15	1,268	1,239	1,253.5	69.73

The results secured in the tests reported herein are sufficient indication that there are numerous fields and soil types located in various parts of the Delta on which cotton wilt and rust are problems of major importance. They show also that the use of potash on such soils is practicable and justified, in that it acts to reduce damage from these troubles and to assume profitable returns from such land. Practically all of the soils along the eastern edge of the Delta, bordering on the foothills and bluffs which limit it, are deficient in potash, and the cotton planted on them suffers from rust and wilt. In seasons such as the present one, 1936, one traveling along the highways in the Delta can readily observe fields in which rust and wilt

are present and are causing great damage. It is in such fields as these, wherever located, that a deficiency of potash is indicated, and in which its use may be expected to render profitable returns.

Crop Insurance

(*From page 5*)

average recorded in the domesday book of statistics, half the required rice tax was remitted, and when the yield fell 70% below the normal, then the entire tax was remitted. The lowest class of non-landed gentry paid no tax of this kind, but the other five non-farm groups paid from five "to" to five koku. A "to" amounts to about two pecks, and look back to my estimate of a "koku," to estimate what the white collar bunch paid in.

As a systematic complement of the local or village rice stores, the Tang administration in 585, two years after they set up the village granaries, established district granaries. These were filled to the brim by a tax in kind. Citizens paid according to three distinct groups. The first or prosperous tillers paid one koku yearly, the next lower class paid seven "to" per annum, while the lower division were docked for only four "to" each season; and these reckoned in our terms mean about 4.96 bus., 3.46 bus., and 1.98 bus., respectively.

Rice was loaned out of these district storages, but it had to be repaid within a year. A third granary recess, or holy of holies as it were, was sealed up and only opened for public convenience when famines occurred throughout the land.

During Oriental famines mention is often made in historical notes: "the government opened its reserve rice granaries and doled out grain to the starving." In Japan the government granaries of this kind were filled only by tax-fee rice, whereas in China there was an extra tithe in kind during extra good years, above and beyond the normal rate. In 1871 the Japanese rice granaries were abandoned for the time being, and their contents sold to the value of about one and a half million "yen," said fund being turned over to the national treasury. At this time loans of rice were laid aside and money loans substituted. For a time they also relieved distress in times of climatic disaster or epidemics, allotting one sixth of one koku of rice for 15 days to a family of five. Bear in mind also that a carefully worked out plan of excusing or postponing the payment of local taxes was in vogue, rated according to the nature and extent of the crop loss suffered each season in relation to the amount of crop adopted in assessing the tax. It strikes me that we might question some of our yellow brethren when we start doping out a sound, farm distress law for America.

IT has been said in a general way by some sage insurance observers that the major risk in all-coverage crop policies must be stated as a mathematical formula. I shall not herein uncover my absolute vacuum in mathematics, but quoting one of the figure sharks aforesaid, this risk may be represented "by the fraction whose numerator is a variable income (based on prices and yield) and whose denominator is a fixed group of costs per acre, established by agreement when the document is written."

Only a few adventurous concerns have tried crop insurance, outside of the realm of hail and tornado. By a little digging I discovered that Minnesota, land of advanced farm ideas,

floated the original company of this kind back in 1899. It was the Realty Revenue Guaranty Corporation, writing an optional-sale contract on grain. Upon payment of a 25-cent per-acre premium, this concern agreed to buy the whole crop covered by the policy at $5.00 an acre, if the insured acted on his option at least five days after harvest and threshing; barring all hazards occurring after September 15.

Still another company operated at a great loss in Montana in 1917 with a policy guaranteeing $7.00 an acre for all the area in grain. Fixed prices per bushel were set forth, and the company was liable for the difference between the actual yield times the fixed prices and the amount of stated insurance. In another instance a Pennsylvania company wrote similar insurance, and their agents were local bankers in the western states who wrote thousands of policies on the eve of a severe drought, so that they might get back some of the loans they made to farmers. Naturally it flopped.

Again in 1920 the Hartford Fire Insurance Company tried out a combined insurance against costs of production plus loss or damage to growing crops, and in testimony at a Senate hearing a few years ago the president said the losses cost his company $2,500,000. Thus, on the whole, we do not face a very eager bunch of profit-taking corporations when crop insurance is mentioned.

I agree that we indeed stand on shaky ground in this matter, sort of half way between rugged individualism and the dumping of all risks on the shoulders of paternal governments. The more we can leave dollars and cents out of our proposition the better off we stand, which makes us cater more to the payment-in-kind theory than to any complex arrangement insuring farmers completely or even partially on a cash settlement basis. Having spent a few minutes thinking it over, I am as well prepared as the average Congressman or magazine scribe to give you the "last word" and the compound conclusion.

As a self-appointed expert, I would limit crop insurance of a national kind to indemnities paid out under these conditions and circumstances: No. 1. When failure is due clearly to natural causes and the farmer is not to blame in the least, or when such damage is general and widespread so that whole counties and states suffer loss.

AS my old book-shelf friend Mayet inquires, "Shall nature bear all the guilt in every case?" Without a bevy of snoops bordering every corn field and cotton patch in our broad land, would it not be a ticklish job to determine how well the farmer fulfilled his obligations—under ordinary years of scattering crop reduction? Then, as we all know full well, group and sectional pressure is a horrible machine when it gets going with all bearings red-hot in a campaign year, intimidating would-be statesmen and causing them to deny that their own home county ever raised half a crop of anything except ballots. In confidence, I would hardly trust myself even, when the government bean bag is wide open. It's so easy to make a thirsty farmer look like a dry spell, and a hungry candidate resemble a national famine! If continued it might put the reverse English on all our agricultural policies in time and give the hill-billy a permanent premium over the chap who wears out a new plow and a pair of overalls between sunrise and sunset.

This brings me to my second great proposal, to wit and to wonder: No. 2. No indemnities unless the crop fizzle is a real one, and never unless the farmer himself bears some share of the risk. In this case I mean a sort of partial payment system, as for instance: In only a moderate loss, all to be borne by the farmer himself;

in a larger proportionate loss, half and half; and full indemnity paid only for a total loss or a very considerable one, considering always the circumstances.

I would divide the dangers into two broad classes—acute ones and chronic ones. Insects and diseases, flood, hail, tornado, and early frost are acute dangers; while protracted cold spells, exceedingly long droughts, and continuous wet spells are chronic hazards. Where intelligent and advance management might tend to lessen the rigors of any calamity, partial indemnities would govern, such as in losses due to insects and diseases, soil depletion, frosts, and mild droughts and short wet spells. With flood, hail, and tornadoes, widespread droughts and unseasonable cold, there would be some excuse for stretching the payments to the utmost, if not to the full extent of the policy. The one who would help the farmer must not lose sight of the fact that there are as many different kinds of farmers as there are divers kinds of preachers, or essay writers. It ill becomes the body politic to pile on its shoulders any system of crop insurance that is open to abuse from town heelers or tired tommies.

And again, we have been deeply immersed of late in drought psychology. It may cause us to forget that there is hardly a season when some group or locality does not experience a diminished harvest, and whoever tackles this job of sorting the sheep from the goats is bound to refuse to run for re-election. There wouldn't be any use anyhow. Nothing short of a dismal dictator would be able to stand the gaff.

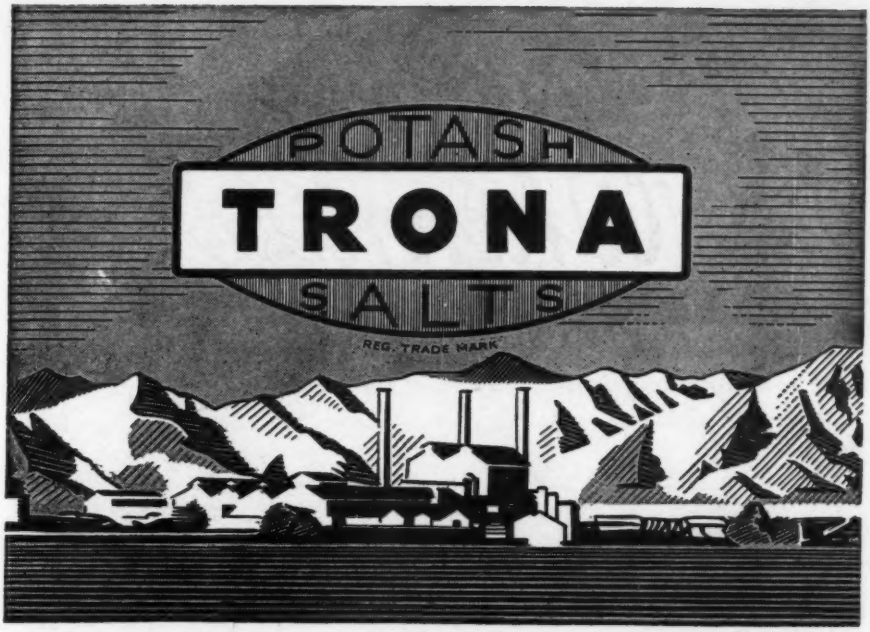
Yet we must do something about this just the same. As long as farm distress was manifested outwardly by good yields and more surplus it was spoken of lightly as "relief," and the mortgages, high taxes, unfair exchange values, and low living standards were sort of remote economic complaints which did not bother the average consumer very much. The farmer got a heap of consolation for his financial woes out of a bumper harvest. It was a sedative which, added to the political soothing syrup he consumed, kept him asleep.

But when a flock of lean years arrived and there wasn't enough moisture on an acre to breed a mosquito from May to August throughout the bread basket of America, this waked up the city denizens. Here was a brand of distress which they shared themselves. They had to change shirts twice a day and keep the sprinkler running on the links all night. With the aid of a dramatic corps of reporters and grain-pit market dopesters, caught in the doldrums of a slow summer for scandal, the drought held first page for weeks, and even had the editorial scribes running to the library looking up unfamiliar farm terms.

WHEN butter and eggs begin climbing in price and the grocer scanned the shelf with dubious mien, they grew anxious. Some of the extreme urbanite customers said they could not see why ducks and cream had to be jacked up out of sight, as long as there were no reports of heat injury to quack grass or milk weeds! Anyhow, the searing effect of three out of five years of crop flops has developed a new and selfishly personal agricultural attitude on the part of our non-farm population.

Thus it's up to the farmers to get what they want before it rains again. Therefore, it's an ill wind (or a persistent "high") which bringeth no good usward. Which means that the legislators may go ahead on crop insurance plans for 1937 with just as much united public support as the general emergency of 1933 provided.

And let's not spoil it by mentioning the Supreme Court. We haven't got that far yet anyhow!



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O'Brien called downtown to see Mrs. O'Connor, to tell her that her husband was locked up for being drunk.

"Why didn't you bail him out, man?"

"Bail him out! Bedad, you couldn't pump him out!"

WHAT—AGAIN?

"What's the idea of all the crowd at church?"

"There's a traveling salesman down there confessing his sins."

A Yale player was teaching some cowboys how to play football. He explained the rules and ended as follows:

"Remember, fellows, if you can't kick the ball, kick a man on the other side. Now, let's get busy. Where's the ball?"

One of the cowboys shouted: "Fergit the ball! Let's start the game!"

BRITISH DIPLOMACY

A story of Winston S. Churchill—told by Gertrude Atherton:

"Shortly after he left the Conservation side of the House (of Commons) for the Liberal, he was taking a certain young woman down to dinner, when she looked up at him coquettishly, and remarked with the audacity of her kind:

" 'There are two things I don't like about you, Mr. Churchill.'

" 'And what are they?'

" 'Your new politics and mustache.'

" 'My dear madam,' he replied, suavely, 'pray do not disturb yourself. You are not likely to come in contact with either.' "

Doctor: "Is the night nurse giving you proper attention?"

Vic: "Not exactly, but I'm perfectly satisfied."

A NOVICE

Gert: "I think it's a shame to send those nice marines to China. What will they do there?"

Peg: "Good heavens, Gert! Ain't you ever been out with a marine?"

Father: "It's simply awful how close these young people sit in a rumble seat."

Wife (smiling): "Yes, I remember how you used to hate the old hammock because it had such a wicked way of pushing us so close together."

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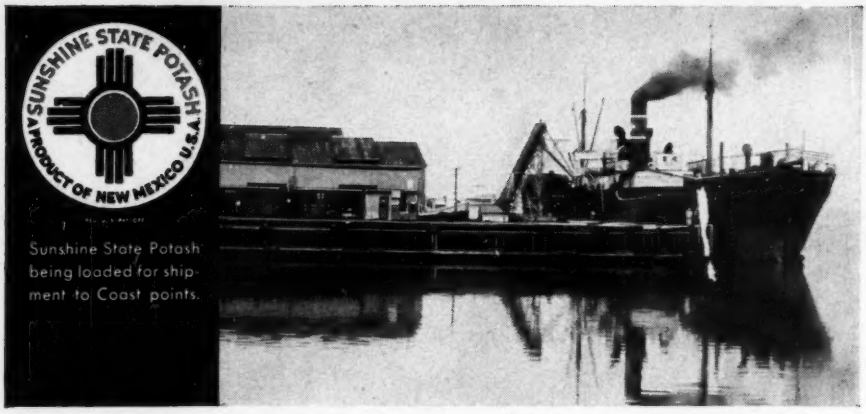

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